AIR ENGINEERING

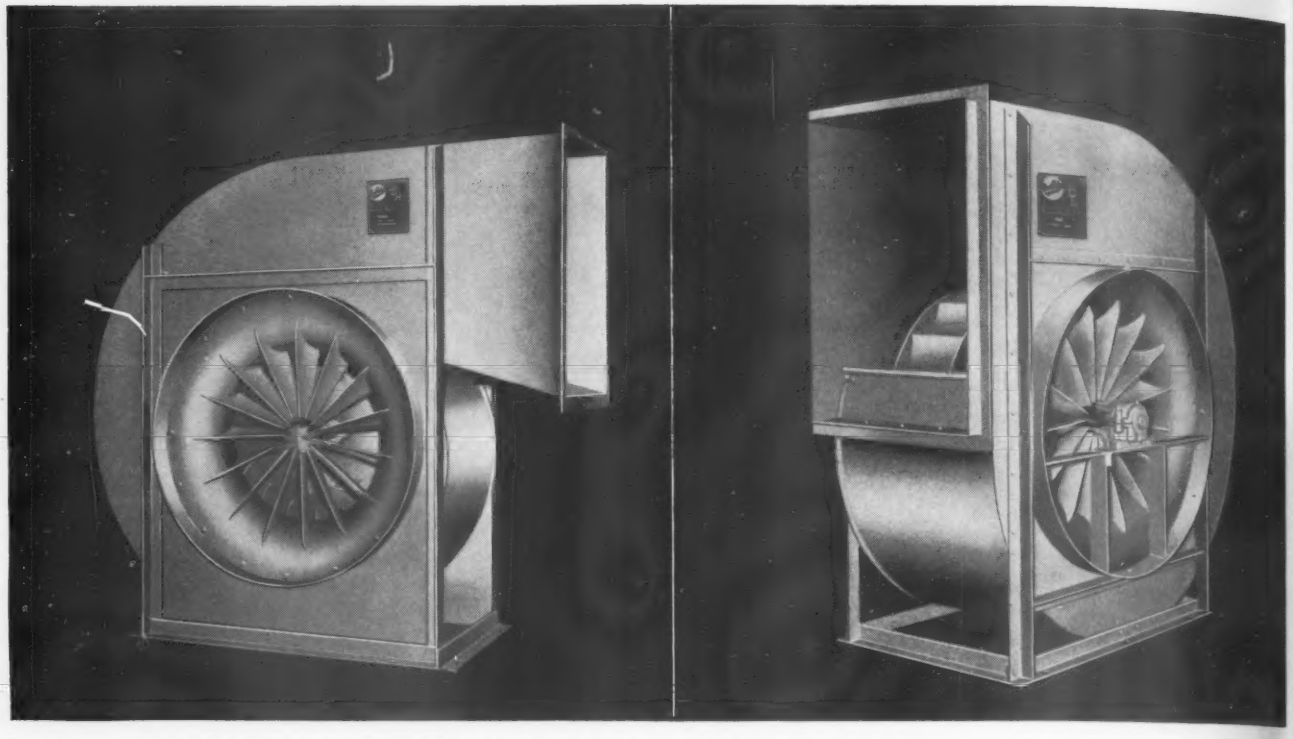
APRIL, 1960

THE UNIVERSITY OF MICHIGAN
APR 7 1960
ENGINEERING LIBRARY

AIR POLLUTION CONTROL • AIR MOVING • AIR CONDITIONING

- *Heating And Cooling Reynolds' New "Aluminum-Showcase"*
- *How To Balance Big Building Air Conditioning Systems*
- *Ten "Don'ts" In Selecting Air Cleaning Equipment*
- *Easy Way To Figure Air Contaminants*

What You Should Kn[illegible] About Air Sanitation In Buildin[illegible]



For Classes III-IV (High Pressures) The "Buffalo" Type "BLH" Fan

For Classes I-II (Moderate Pressures) The "Buffalo" Type "BL" Fan

FOR THE BEST ENGINEERED JOBS, SPECIFY BUFFALO "JOB-SUITED" FANS

For central system applications you don't have to accept a "compromise fan", loosely designed to cover any and all pressure requirements. "Buffalo" builds *two* fans, each engineered to fulfill specific pressure requirements to the highest possible degree. Brief engineering details on these "no compromise" "Buffalo" Fans are given below.

The "Buffalo" Type "BLH" Fan is recognized by engineers and contractors alike for its outstanding performance in Classes III and IV service. The "BLH" maintains an extremely high efficiency over a broad operating range. The smooth inlet bell with matching shroud, directional inlet vanes, backward-curved blades and divergent outlet all contribute to quiet operation and minimum turbulence. "Buffalo" engineering features, plus husky construction, add up to an efficient high pressure fan that will deliver long, faithful, maintenance-free service. When you plan a conduit system or other Class III-IV installation, be sure to specify the "BLH". Call in your "Buffalo" representative or write for Bulletin F-200.

The "Buffalo" Type "BL" Fan has gained wide acceptance for peak performance in major Class I and II installations throughout the country. Non-overloading, the "BL" provides quiet, stable, output from free delivery to shutoff. The smoothly-curved inlet bell, with directional guide vanes and matching shroud, assures minimum turbulence. Highest efficiency is attained by the streamlined wheel with backward curved blades, factory tested and balanced to hold vibration to an absolute minimum. The correctly shaped scroll of the wheel-contoured housing further contributes to smooth air flow. For full information on the rugged, reliable "BL" Fan for Class I and II conditions, contact your "Buffalo" engineering representative. Or, write direct for Bulletin F-104.

You get a *value dividend* with the "Q" Factor — the built-in QUALITY that provides trouble-free satisfaction and long life in *every* "Buffalo" product.

"Buffalo"

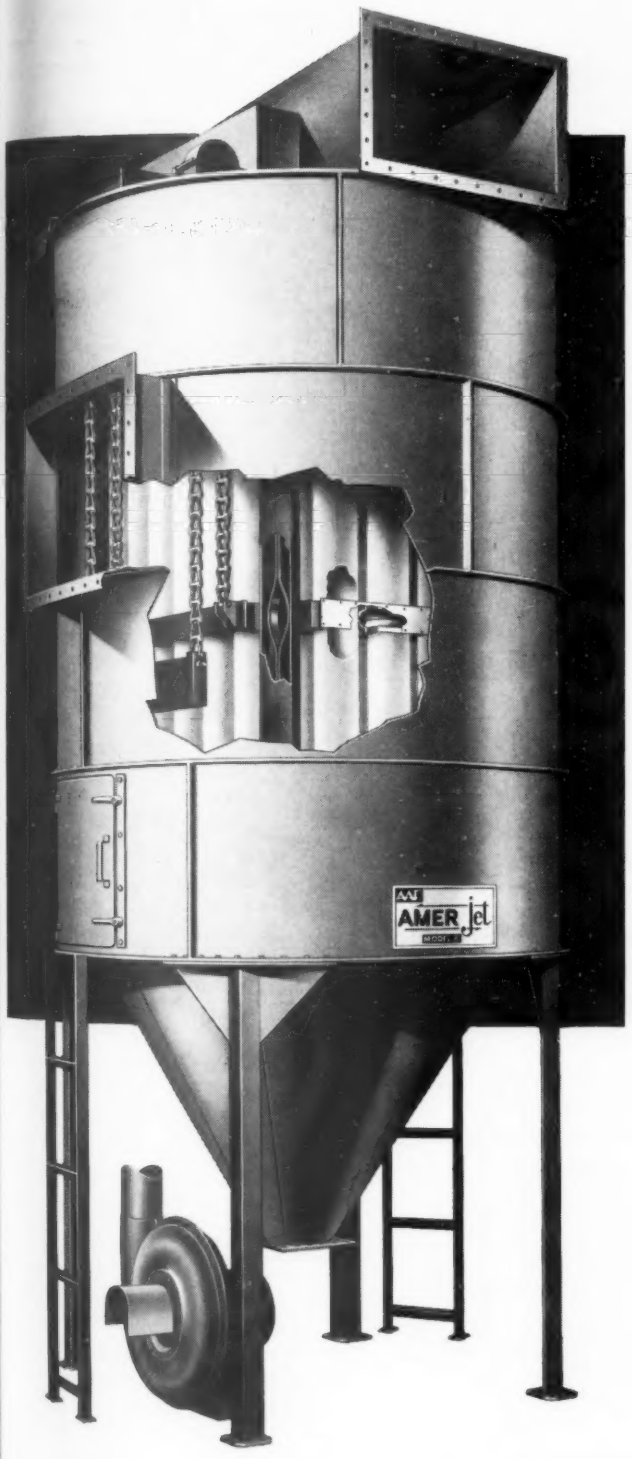
BUFFALO FORGE COMPANY • Buffalo, New York

Buffalo Pumps Division, Buffalo, New York

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING

NOW—a constant-volume, compact fabric dust collector!



AAF's new Model B

AMER Jet

This new AAF unit answers the need for a compact dust collector capable of handling heavy dust loadings of materials of varying nature—with a constant pressure drop that assures accurate control from most dust sources. Check these important features of the new AMERjet:

1. **FEWER FILTER BAGS**—A 10,000-cfm AMERjet contains only twenty-six 21-ft. bags compared with 200 for a conventional unit of the same height.

2. **GREATLY REDUCED SPACE REQUIREMENT**—Requires just half the area utilized by tube-type or flat-envelope cleaning units!

3. **SUPER RUGGED DRIVE**—Allows bag cleaning mechanism to operate even under extreme dust loadings.

4. **MAINTENANCE REDUCED**—All housing and hopper panels are of galvanized construction, need no painting. Only two points for semi-annual lubrication. Complete set of bags replaced in one morning.

5. **MODULAR DESIGN**—AMERjets can be interconnected for large installations. This allows servicing of any unit without shutting down system.

6. **JOBSITE CONSTRUCTION REDUCED**—No special shipping problems. All sizes fit standard highway trailers.

For complete information on the new Model B AMERjet, write for Bulletin 279C. Address: Mr. Robert Moore, American Air Filter Company, Inc., 305 Central Avenue, Louisville, Kentucky.

AAF **American Air Filter**

BETTER AIR IS OUR BUSINESS

100 percent air recirculation? you're crazy!

Total recirculation isn't the answer in every case but it gives the best purity and the lowest cost for many ventilating situations. The point is, Barnebey-Cheney activated charcoal air purification *lets you design for total recirculation* of inside air, and save substantially in both initial investment for heating and cooling equipment and operating costs.

A typical well designed system uses outside air in the spring and fall for cooling and 100% recirculation with activated charcoal purification in the summer and winter. In most buildings normal infiltration and the opening of doors provides plenty of oxygen. Pressurizing of the building can be incorporated if desired. Write for Bulletin T-321. Barnebey-Cheney, Columbus 19, Ohio.

activated charcoal air purification

Barnebey Cheney

Letters

To Train Trane Students

Editor:

The instructor of our student engineer group is interested in obtaining two copies of the article, "Techniques For Designing Duct Systems," that appeared in your November, 1959 issue, starting on page 29.

Helen O'Dea
Librarian
The Trane Company
La Crosse, Wis.

Wants Back Issues

Editor:

Your AIR ENGINEERING magazine for January, given to me at the (2nd Southwest Air Conditioning Exposition) show in Dallas, contains severela articles of interest.

The articles are factual and to the point. In checking at the library, I find desirable articles in several earlier issues. Perhaps since this is a new magazine you have additional copies of all issues starting with last April. Please advise cost of all issues, with my subscription at the present time.

G. H. Neptune
Gustin-Bacon Mfg. Co.
Kansas City, Mo.

Editor's Note:

As with all magazines, our press overrun, beyond what we actually need for fulfilling our thousands of paid subscriptions, consists of relatively few copies. Therefore we are usually not able to satisfy requests for back copies much beyond the first two or three months after they appear, due to the brisk demand for extra copies of articles, issues, etc. From time to time we do have reprints available, and as they roll off the press you will find a brief note as to their availability and prices, in these columns.

(Please turn to page 4)

Use Communications Center, page 35, for requesting more information about articles, advertised products, literature, and for comments about any of the editorial material in this issue of AIR ENGINEERING.

If you wish to contact manufacturers directly, street addresses are given. But please mention you saw it in AIR ENGINEERING.

AIR ENGINEERING

VOL. 2, NO. 4 APRIL, 1960

DEDICATED TO THE SCIENCE OF AIR POLLUTION CONTROL
AIR MOVING • AIR CONDITIONING

FEATURES

Unique Heating-Cooling System in Aluminum "Showcase" Building 22
New Reynolds Metals Co. Midwest office building posed design problems

All About Air Sanitation In Buildings 29
An unbiased critique of effectiveness of current methods

How To Balance Big Building Air Distribution Systems 34
Beginning a series on this subject, including instrumentation

Easy Way To Check Air Contaminants 39
Author points out quick way to determine air contaminants in a space

10 Don'ts In Dust Collector Selection 50
Factors to consider in selection, application, cost

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COVER

Photos for this month's cover were supplied by Surface Combustion Division, Midland-Ross Corp., manufacturers of the Kathabar lithium chloride system, and by Apasco Corp., makers of special fitted filter masks worn by operating room personnel. Masks are made of media supplied by Cambridge Filter Co., and are similar in filtering effect to sub-micron type filters used in air distribution systems. See story on page 29.

AIR ENGINEERING is published monthly by Business News Publishing Company, at 450 West Fort Street, Detroit 26, Michigan. Subscription prices: United States, Canada: $3.00—1 year; $4.50—2 years; $6.00—3 years. Foreign: $5.00—1 year; $8.50—2 years; $12.00—3 years. Single copies 50 cents. Second-class postage paid at Detroit, Michigan. First issue April, 1959. • CHANGE OF ADDRESS. Notify AIR ENGINEERING and your local post-office of both your old and new addresses including postal zone numbers by 12th of preceding month.

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cleaner, fresher
purer air
Imagine the sweetness of air in a breezy summer meadow. Think of air just as clean and pure in a home. Install Dust-magnets. For air conditioners and furnaces, Dust-magnet filters trap particles as small as 4/10ths of a micron. They're electrostatic, permanent . . . when dust-laden simply rinse clean and replace in unit. No messy oil coatings. As you live and *breathe* . . . install Dust-magnets!
a product of STODDARD INDUSTRIES
DUST-magnet filters
3383 E. Layton Ave. • Cudahy, Wis.

Letters

(Continued from page 2)

Gas vs Electricity Reprint Available From A.G.A.

The interesting and controversial article on Gas vs Electricity As A Fuel (pg. 20, January issue) is now available as a reprint from the American Gas Association.

The article, by G. Gatchell, of Gatchell and Burwell, consulting engineers, Detroit, details an engineering and cost analysis of a church and a school in the Detroit area. Heating systems for both buildings were designed for both gas and electricity, and plans and specifications on both methods of heating were sent out for bids. Decision on which fuel to use was based on bids submitted by mechanical contractors, and on cost of fuels. This is one of those rare, really factual articles because the owner permitted the engineer to design two separate systems in an effort to establish accurate installation and operating cost data on both methods of heating.

Cost of this two-color, six page reprint is 9¢ each. Please send your order direct to:

Order Department
American Gas Association
420 Lexington Avenue
New York 17, N. Y.

(Please turn to page 8)

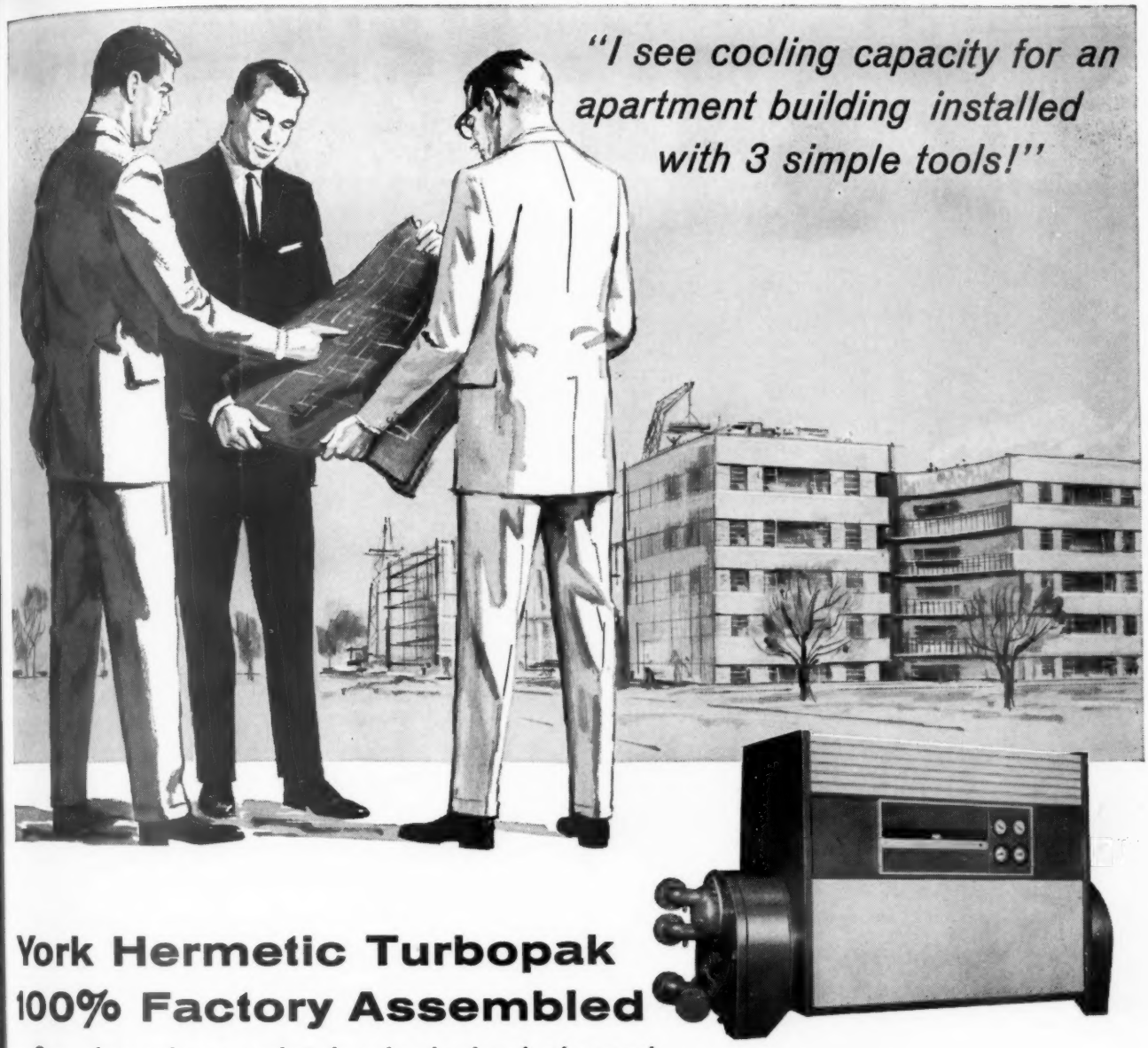
Open Forum On White Rooms

We invite our readers to participate, in these pages, in an exchange of, or request for, information and data on super-clean "White Rooms."

As you know, many of today's manufacturing processes, from automatic transmission and rear-end assembly, to missile guidance systems assembly, must be carried out under ultra-clean air conditions.

While standards for ultra-clean air may vary according to the need of the individual firm, many of our readers may have problems relating to White Room construction, design, filtration, air conditioning, personnel clothing, air locks, air movement, air distribution, etc.

We therefore invite you to submit any data you may wish to share with others in the field of air engineering, as well as share in data presented by others in these pages.



York Hermetic Turbopak 100% Factory Assembled

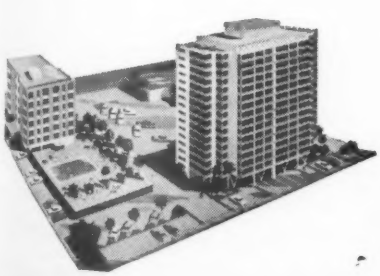
–One piece rig completely wired, piped, charged

CUTS JOB-SITE COSTS—The Turbopak is fully factory packaged including insulation. Shipped and rigged as a single unit—no aligning or refrigeration piping on the job. Simple water and power connections are all that's necessary for installation.

50% SMALLER—A 130-ton Turbopak is only 14′ long, 5′ deep and 6¾′ high—half the size of other designs. Space-saving unit handles easily, fits in confined areas. Exclusive precision-built Borg-Warner power transmission accounts for unit's compactness.

LIGHT WEIGHT—Exclusive tri-duty shell and advanced centrifugal design keep weight to a minimum. No structural base or foundations needed. Automatic electronic control center is factory-wired for quick field connection. Prerotation vane capacity control.

ACCESSIBLE FOR EASY SERVICING—Quiet, trouble-free hermetic centrifugal unit is enclosed in an accessible casing should servicing be necessary. Otherwise, smooth, attractive enclosure requires only dust-cloth maintenance. 65 to 600 tons capacity.



Another York Trail Blazer Concept Proved In Action At *Birch Towers, Ft. Lauderdale, Fla.*—A compact 150 hp York Turbopak supplies chilled water to 137 York 3-pipe Hi-I Induction units, bringing occupants of these luxurious apartments the ultimate in instant personalized comfort.

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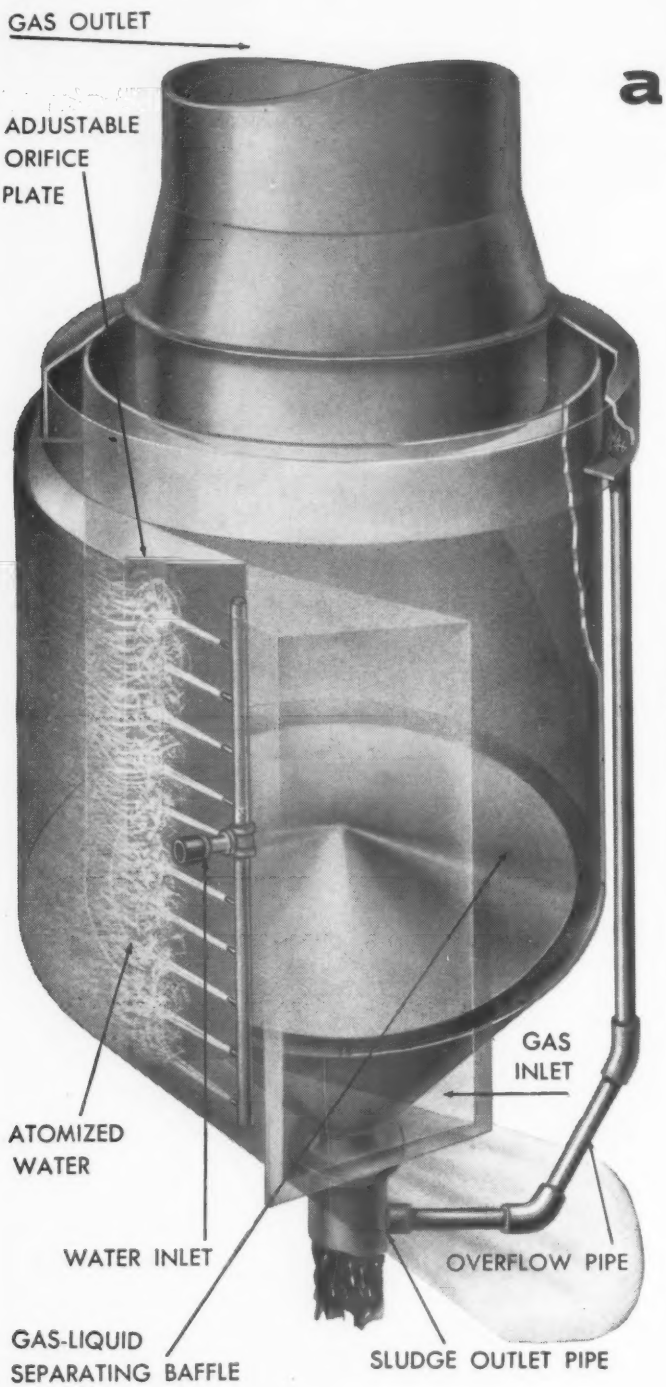

a NEW scrubber for ultra-efficient dust and fume control

THE DUCON TYPE VO Oriclone® SCRUBBER

- 50% less space requirements than other high energy scrubbers.
- Higher operating efficiency at lower horsepower.
- Adjustable orifice maintains peak efficiency when operating conditions vary.
- Economical in first cost and operating cost.
- Simplicity of design permits economical alloy construction or acid brick lining.
- 99% efficiency below 2 micron and in sub-micron range.

The Ducon Type VO Oriclone Scrubber—the only high energy scrubber with an adjustable orifice—is the most effective and most economical dust and fume collector for a wide range of industrial applications, including recovery of catalyst dust, cupola dust and fumes, acid mists, tar fog and many others.

The Oriclone Scrubber is a completely integrated unit that performs the entire separation cycle. No subsequent collector is needed.

Send today for detailed information on Oriclone.

the name in DUst CONtrol

Patent Pending

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EDITORIAL:

Response . . . And Dedication

This issue marks the beginning of the second year of publication of AIR ENGINEERING. The past 12 months have seen this new concept in technical publications climb from zero to over six thousand paid subscribers, a sign of reader acceptance of which we are most appreciative and about which we feel a great sense of editorial responsibility.

To the degree we have succeeded in making each issue bear one or more articles that will ultimately help you do your job better, faster or easier, we have succeeded in achieving our original publishing objectives.

Because AIR ENGINEERING cuts across all types of industrial activities and because, in so doing, it must cover all aspects of the treatment of air for human comfort and plant process, your editors have had to make use of the many allied arts and sciences of the engineering of air to keep you informed and up-to-date in this complex field so vital to the welfare of all of us.

A quick glance through the 12 issues of AIR ENGINEERING, for example, reveals a broad range of material presented. The art and science of managing air to make it useful and healthful for man in structures and manufacturing processes is indeed many-faceted.

From the very beginning of AIR ENGINEERING, it has been our concept that the men who are concerned with air in industry and the men who design air systems for buildings, also are concerned with the treatment of air in *all* its aspects.

To satisfy these broad interests of air engineers, we have presented articles ranging from air quality control in the beryllium processing industry to complete engineering descriptions of unique and efficient ways of designing and laying out air conditioning and heating systems in office, commercial, institutional and factory buildings.

Response to the material presented thus far has been most gratifying. A great many of you have voiced approval of material in AIR ENGINEERING when we have met you in person, on field trips or at conventions. Still more of you have taken the trouble to write directly to us with ideas, suggestions and comments about topics you would like to see covered in AIR ENGINEERING, and about how you feel about what has already been presented.

(Please turn to following page)

Editorial (Cont.)

Response . . . And Dedication

(Continued from preceding page)

One such letter, typical of many we have received, has just arrived, and because it sums up so well the sentiments of so many of our readers, we present it here in toto:

Editor:

"We have been an AIR ENGINEERING subscriber since the initial copy of this magazine was published some time ago, and we would like to express briefly our opinion of your publication.

"So many of the other technical trade magazines we read seem to us to be getting too elementary in their contents. They are, in other words, getting 'stale.' We do not get anything new from them in concepts or ideas.

"Your magazine seems to us to be entirely different, in that we have gotten several fresh viewpoints and some new concepts from it. Everyone here likes it.

"Please don't ever let it become 'mine-run.' If you always keep its content fresh, new and advanced in scope and concept, you will always have an interesting publication."

R. Kay Crandall
Chief Mechanical Engineer
McGeorge, Hargett and Hoag
Engineers and Architects
Cleveland, Ohio

Letters like the above give your editors a sense of dedication to the readers of AIR ENGINEERING. We pledge ourselves to rise above the mediocre, and to keep the pages of AIR ENGINEERING sparkling with up-to-date technical data of genuine usefulness and value to you.

Letters

(Continued from page 4)

From Japan

Editor:

We are an importer and also engineering firm in the field of air filtration. We have read the article entitled "What You Should Know About Respirators" (p. 42, January issue, p. 39, March issue, p. 40 April issue) with great interest.

We shall be very much appreciated, if you would be kind enough to send your technical informations covering respirator which will be effective against dusts ranging over 0.1 - 0.5 micron, at your early convenience.

Teiji Watanabe
Managing Director
Shinwa Trading Co., Ltd.
Sumitomo Bank Bldg.
Chui-Ku, Tokyo, Japan

His Issues Takes Powder

Editor:

I sent you a subscription for two years and enclosed a letter asking you to send my magazine to my residence, because I seldom find my copy after it has gone through a half-dozen hands.

My February issue has already taken a powder and no one seems to know where it has gone. Let's encourage these free-loaders to spend some money for their own magazine if they want an education in AIR ENGINEERING.

I feel kind of sick when I miss one of the issues, because I know I am missing something good. Therefore, if you are interested in helping me remain healthy and happy, please send my issues to my home address.

Leonard N. Goldston
Senior Chemist
Div. of Air Pollution Control
Cleveland

Pilot Studies On Gas Cleaning At Sewage Treatment Plant

Editor:

While we are just getting ready to install full-scale scrubbers in the West-Southwest Sewage Treatment Works, you might be interested in a brief summary of what we have done up to the present time as far as our pilot studies are concerned.

The West-Southwest Sewage Treatment Works generates power and dries sewage sludge, burning pulverized coal in the furnaces. The plant is equipped with precipitators and those with handle gas from steam generators only, remove about 98 percent of the fly ash.

The precipitators used for cleaning the stack gases from the driers have not been as successful. Grease in the sludge vaporizes in the drying system, and then condenses on wires of the precipitator. After a few hours of operation, the wires become covered with a thick coating of grease, ash and dried sludge, dropping efficiency of the units to about 40 percent.

At times, accumulation of grease and sludge would ignite, and resulting fire would ruin the interior of the precipitator.

For about two years, the District (Metropolitan Sanitary District of Greater Chicago) experimented with different types of scrubbers and wet precipitators. This work was carried on in conjuction with O'Mara and Flodin, Inc., of Los Angeles. The last prototype unit installed has a capacity of 3000 cfm of gas from drying units, at 300F. The unit consists of a scrubber designed by National Dust Collector Corp., of Chicago, followed by a wet precipitator consisting of 25 cells, 6 in. square.

Since liquid from the scrubber and precipitator has a pH of

(Please turn to page 10)

BLAST FURNACE GAS WASHING

Chemico P-A Venturi washers selected for 36 installations at 20 separate plants...

In furnaces from coast to coast, the Chemico P-A Venturi washer is proving the single most economical and effective method of cleaning blast furnace gases. Prior to the introduction of the Venturi blast furnace washer, the dust content of the gas from conventional primary washers ranged from 0.15 to 0.35 grains/CF. The Venturi washer can achieve results as low as 0.005 grains/CF.

Low initial cost, inexpensive installation and virtually no maintenance are the more obvious economic advantages of Venturi blast furnace washers. In addition, however, Chemico Venturi washers require very little water—one-third as much as conventional washers—and permit complete recycle.

They are rugged units which have proved their reliability and long life in actual working furnaces. Also important is their ability to handle wide fluctuations in gas volume without sacrificing cleaning efficiency. With 36 units now in operation or on order, you can be certain of proven performance with a Chemico P-A Venturi washer.

If you are considering the installation of gas cleaning equipment in a blast furnace, a Chemico representative would be pleased to show you the kind of top-performance job you can expect from a Venturi washer. And remember, Chemico handles the complete job... PLANNING, DESIGN, ENGINEERING, ERECTION and START-UP.

CHEMICO

CHEMICAL CONSTRUCTION CORPORATION
Gas Scrubber Division
525 West 43rd Street,
New York 36, New York

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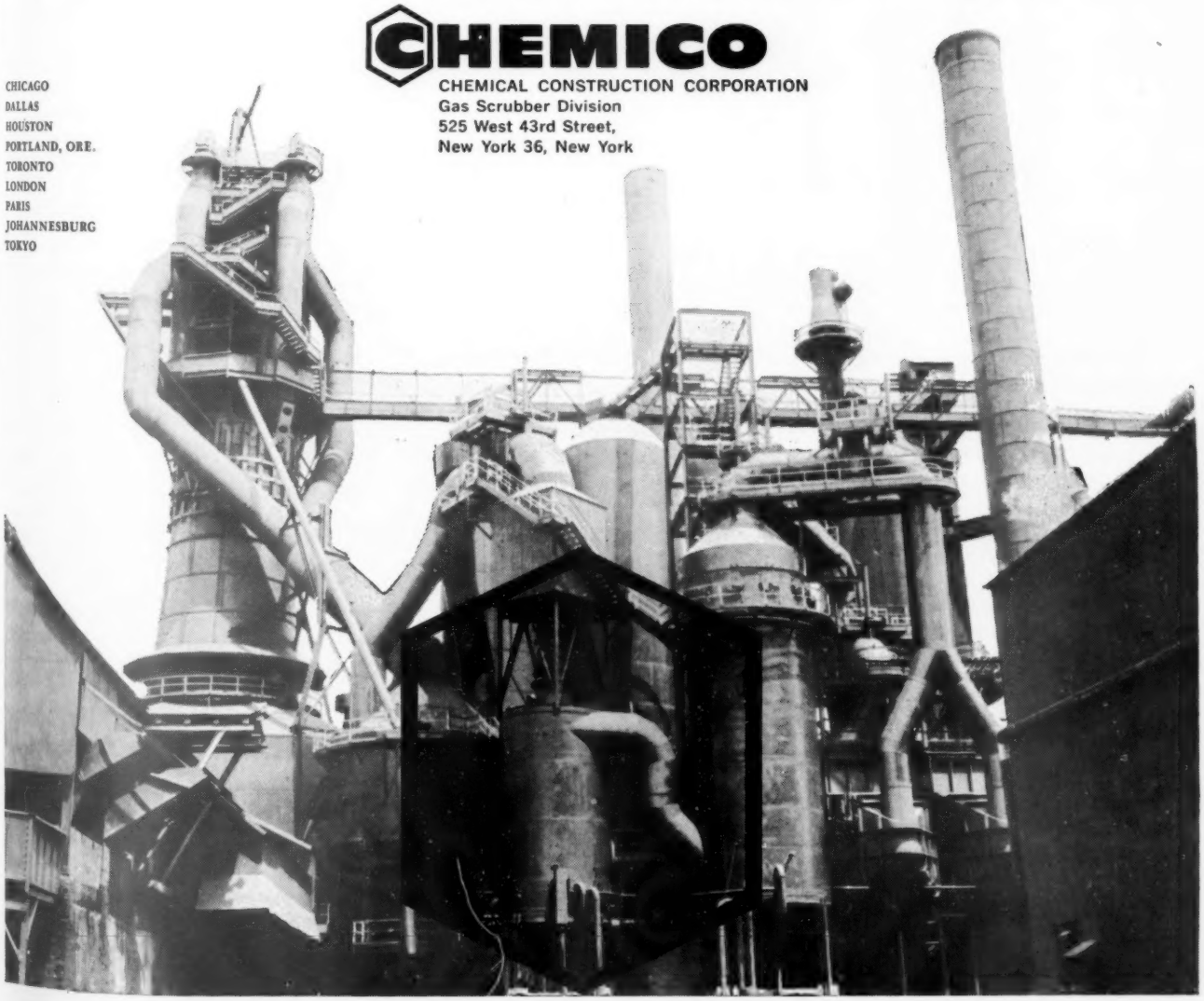

New DAY "RJ" Dust Filter

CONTROLS DUST SAVES DOLLARS

only 3 moving parts

Built under patents of The DAY Company and H. J. Hersey, Jr.

Because of its new, simplified design the DAY "RJ" dust filter will save you many dollars on initial investment, installation, operation and maintenance. Some of the important new construction features of this dust filter are: a new, quick-opening reverse-air, counter-flow valve for maintaining filter media porosity; a new, reverse-air pressure blower arrangement, and new, air tight, yet quickly opened inspection doors.

This patented DAY dust filter has only 3 moving parts but controls dust effectively, efficiently (99.99+%) and economically. It represents the latest refinement in a long-tested, plant-proven dust filter. Using felted filter sleeves to capture dust, the "RJ" is now available in 5 sizes for handling from 300 to 6400 CFM of air (for larger capacities, multiple groupings are furnished).

For more detailed information write toDAY for free Bulletin G-30. It's filled with facts, specifications and dimensions.

The DAY Company

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EQUIPMENT . . . SYSTEMS . . . INSTALLATION

Letters

(Continued from page 8)

about 2.3, the scrubber housing and the entire precipitator cell structure were made of "Corite", a glass reinforced polyester resin.

Results of operating tests on the prototype unit indicated that the scrubber removed all the dirt particles, all water evaporated in the driers, and about half of the grease.

The precipitator removed an additional 35 or 40 percent of the grease. Since we feel our greatest problem is a large amount of fly ash and sludge dust, plus odors from the grease, it was decided to install a scrubber only, having a capacity of 55,000 cfm in one of our drying lines, the scrubber to be arranged so that a wet precipitator could be added later if desired.

We feel that precipitators create a sizeable maintenance problem and want to avoid their use, if possible.

Since our experience with scrubbers is limited to the prototype unit, I think it would be better to defer an article on our experience until after the first full scale unit has been placed in operation, which should be in about six months.

C. P. McLaughlin
Engineer of Mechanical Design
Engineering Department
The Metropolitan Sanitary
District of Greater Chicago

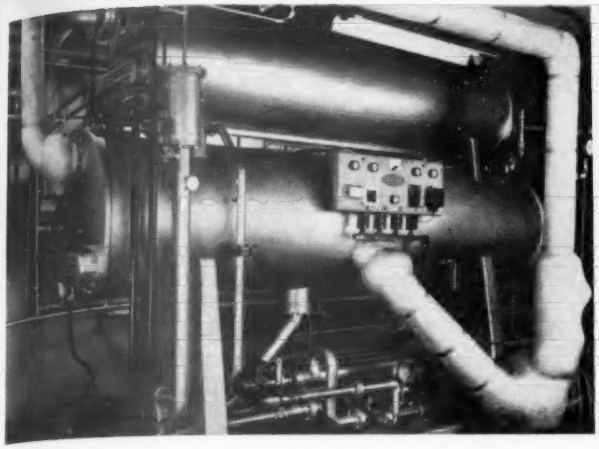
Editor's Note:

Look for a full-scale report on the gas scrubber installation at the West-Southwest Sewage Treatment Works, as noted above, in a Fall issue of AIR ENGINEERING. *Meanwhile, any specific requests you may have for data you would like to see presented in this article can be made on the cards in the Communications Center, page 35.*

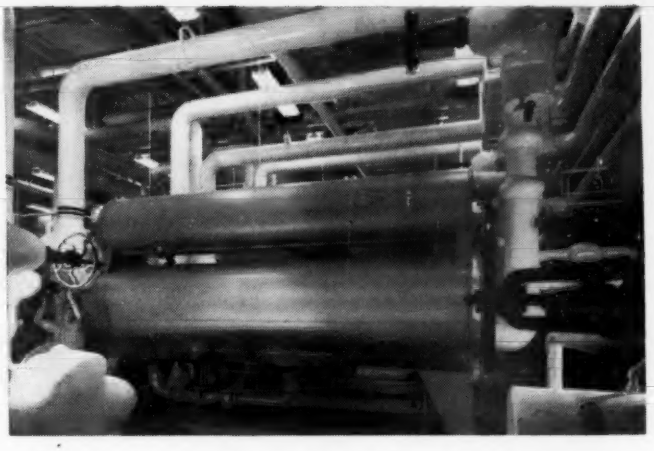
(Please turn to page 12)

Respirator Series Next Month

Due to space limitations, the continuing series of articles on "What You Should Know About Respirators" will not be presented in this issue. Instead, Part III of this series will continue in the May issue.



FOURTEEN YEARS AGO, the first Carrier Absorption Refrigeration Machine was installed in the Sealright Corporation's plant in Fulton, New York. This pioneer machine has been in continuous operation ever since.



TODAY, here's one of more than 1500 Carrier Absorption Refrigeration Machines in operation around the world. Today's modern Carrier automatic models cover a wide range of capacities from 50 through 1000 tons.

4 FACTS

TO REMEMBER WHEN YOU SPECIFY ABSORPTION REFRIGERATION

1 Carrier is years ahead of any other manufacturer in this specialized field. Carrier designed and built its first Absorption Refrigeration Machine fourteen years ago. This pioneer machine is delivering efficient, dependable service around the clock.

2 Today more than 1500 Carrier Absorption Refrigeration Machines are serving factories, office buildings, hospitals, hotels, schools, universities and other structures around the world. They have established an unmatched record for economy of operation.

3 Since the first machine, Carrier has effected many advances in design in its models. Today's Carrier Automatic Absorption Refrigeration Machines deliver the last word in efficient, reliable, low-cost cooling from low-pressure steam or hot water.

4 Carrier's long background of experience on every type of application is at your disposal. Qualified representatives are ready to work with you on your projects. Write Carrier Corporation, Syracuse 1, N. Y. In Canada: Carrier Engineering Ltd., Toronto.

BETTER AIR CONDITIONING FOR EVERYBODY EVERYWHERE

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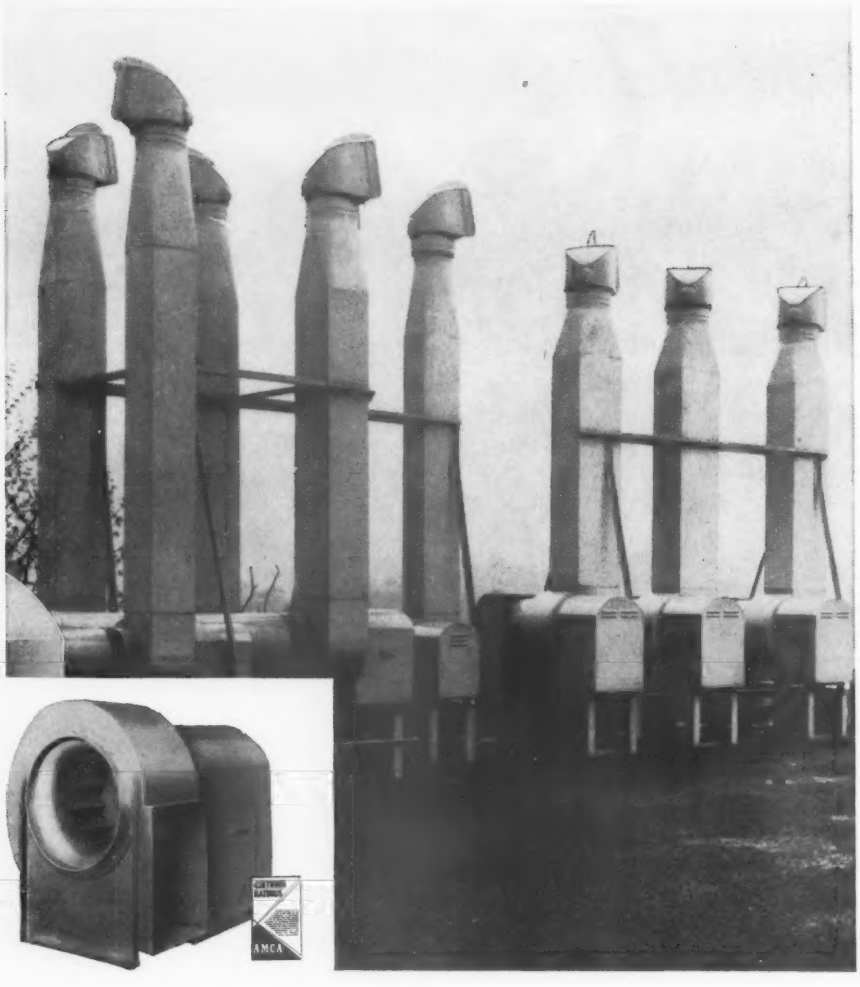

Peerless Electric Blowers Remove Fumes At Gulf Research Center

Shown here are Peerless Electric Backward Curve Blowers applied to exhausting flammable and harmful vapors from the cleaning room of Gulf's Automotive Products Evaluation Laboratory. These heavy duty blowers have arc-welded wheels with cast iron hubs and non-slip taper lock bushings.

Peerless Electric can engineer a blower for *every* important air moving job. Units, similar to this, are available for continuous supply and exhaust duty in air conditioning systems of schools, hospitals, public buildings and industrial installations.

On your next job, let Peerless Electric engineer your air moving needs. Write to: *Peerless Electric Division, H. K. Porter Company, Inc., W. Market Street, Warren, Ohio.*

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Letters

(Continued from page 10)

Dust Collectors, Anybody?

Editor:

I am a plant engineer at a furniture plant and would appreciate your recommendations on some good literature pertaining to dust collecting systems. Interested in function, maintenance and trouble shooting of dust systems.

Don Jackson
Plant Engineer
Lenoir Chair Co., No. 1
Lenoir, N. C.

Factory Ventilation Reprint

Editor:

Please send me one of the copies of the four part series on Factory Ventilation.

George Danchi
Industrial Hygiene Engineer
Indiana State Board of Health
Indianapolis

Editor's Note:

Reprints of this article are now being made ready for press, and information on single and quantity prices will be available shortly.

Wants Respirator Weaknesses Mentioned

Editor:

I hope in your series about respirators, you will cover the subject of weaknesses in respirators. Just as a Hi-Fi set is only as good as its weakest component, so a respirator is only as good as its greatest source of leakage . . . through filter, face fitting, filter holder, flutter valves, etc.

*A. Wendell Cerrikov**
Health Physicist
Naval Research Laboratory
Washington 25, D. C.

**Since the signature was not clear, our apologies if misspelled.*

Editors's Note:

See articles.

Use Communications Center, page 35, for requesting more information about articles, advertised products, literature, and for comments about any of the editorial material in this issue of AIR ENGINEERING.

MSA reports on:

How Air Filter Efficiency Is Tested

MSA presents the following information in a spirit of helpful enlightenment. It's directed to those of you in industry who want to know more about air filter efficiency and how it's determined. A review of this report may pose a question or two in your mind. We hope you will write us for answers to your specific air cleaning problems.

TESTS BASED ON WEIGHT—Efficiency equals total weight of dust in unfiltered air stream divided into total weight of dust stopped by filter, times 100.

The best known weight tests used today are the ASHVE and Bureau of Mines procedures. Both use prepared "standard" dusts of relatively large particle diameter. Most sources agree that "atmospheric dust" would be the most representative material to use on a weight test for space filters. But so far, the average atmospheric dust condition has not been selected. Type of material, concentration, particle size, etc., varies widely from one location to another. And even within the same location from time to time.

TESTS BASED ON DISCOLORING—Efficiency is found by comparing previously rated standard stains.

These tests follow the practice of comparing stains produced on white filter paper by the exit of air from the filter being tested with a series of known standards made by staining papers with different volumes of untreated aerosols.

Comparisons are made visually or by a densitometer (degree of light penetration). NBS or ASHVE dusts are most frequently used on these tests although some reports are based on use of atmospheric dusts.

Efficiencies reported by discoloration are usually lower than those reported by weight; but considerably higher than those obtained by count.

TESTS BASED ON COUNT—Efficiency equals total number of particles in unfiltered air stream divided into total number of particles stopped by filter, times 100.

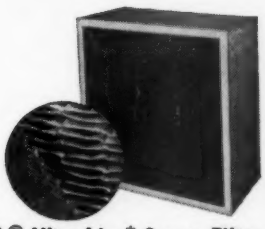
Efficiencies obtained by count are the most exacting measure of a filter performance since large and small particles are rated equally. They can be counted by means of a microscope or by light scattering techniques.

The most critical standard test and the most difficult for any particulate filter is the Chemical Corps DOP test on which penetration of the 0.3 micron diameter smoke particles is evaluated by particle count.

The DOP Penetrometer, used on the M-S-A UltraAire Space Filter, is now considered the most convenient tester available. It is sensitive to penetrations as low as 0.001% by count. It's sometimes difficult to appreciate the difference between 99.95% efficiency and 99.90% efficiency.

TESTS BASED ON RADIOACTIVITY—Efficiency equals radioactivity of unfiltered air stream divided into radioactivity of particles stopped by filter, times 100.

One of the earlier tests on this basis involved the use of triphenyl phosphate containing radioactive sulphur. This or like materials in a uniform aerosol are passed through filter paper or pads, and segments of these are analyzed with a Geiger Counter or some other similar instrument. Such test procedures are still confined primarily to AEC activities.



M-S-A® UltraAire* Space Filter

Light weight, fire-resistant, unusually strong, and ideal for high humidity service. Individually pre-tested and proved at least 99.97% efficient in removing particles of 0.3 micron diameter.

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Honeycomb-type fold without separators is admirably suited to cylindrical element construction. This shape is preferred for pressure systems. Weighs only one pound. Easy to handle. Inexpensive to ship.

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Offers the efficiency of an Electrostatic Precipitator without the high cost and without the possibility of arcing "blow-off." 85-95% certified efficiency on NBS Atmospheric Air Dust Stain Rating.

M-S-A® Air-O-Kay* PreFilter

Impingement type panel prefilter which can be used oiled or dry to remove lint and other large air-borne particles from the atmosphere. 60-70% certified efficiency on NBS Stain Rating.

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Write for illustrated technical bulletins on M-S-A Space Filters related to your particular system problem. Ask an MSA Representative for system recommendations.

Fluid Purification Specialists For 45 Years

MINE SAFETY APPLIANCES COMPANY

201 North Braddock Avenue, Pittsburgh 8, Pa.

Other Fluid Purification Equipment includes catalytic filters for jet aircraft cabin air; air separation plants; inert gas generators, space capsules; bomb shelters; air line filters; jet fuel and hydraulic fluid purification.

New Air Sanitation System Claimed 99.9 Percent Effective

Announcement of one of the major break-throughs in a century in man's struggle against infectious germs was made by Lester M. Finklestein, president, Mt. Sinai Hospital, Los Angeles.

Mr. Finkelstein stated that through the use of what he termed a revolutionary "Aseptic-Air System," first used by Mt. Sinai Hospital, the Hospital's surgeries are now conditioned with sterilized air, delivered to surgical operating rooms 99.9 percent free of *all* bacteria.

The new Aseptic-Air System was developed by Reginald Robbins of Los Angeles in collaboration with Professor Gennady W. Potapenko of California Institute of Technology. Dr. Potapenko is the noted physicist who developed and secured basic patents in the field of radar.

Coming soon, a complete engineering report on the air engineering aspects of this installation.

Industrial Building Boom Forecast For Sixties

According to Architectural Forum, industrial construction is to rise by 72 percent during the next ten years. Annual rate of expenditures for private non-residential construction is to jump to $15-billion, with total for the decade to be $125-billion. By 1969, of total construction, including residential starts, the government's share in all construction will be about 33 percent, as compared to 29 percent during the 1950's.

And the American Marietta Co., in a just-issued long range forecast for the next 15 years, states that the American economy will double, demands for electricity will triple. During 1960, says this report, industry and business, including public utilities, will spend an estimated $36-billion for new plant and equipment. By 1975 this outlay will have increased to $66.7-billion annually.

Air Pollution and Health Study in Detroit-Windsor Area Inconclusive

In a pilot study of a number of high and low pollution areas, covering a period of two years in the Detroit-Windsor (Canada) area, it was found that monthly rates of sickness in all areas under study followed a similar chronological pattern, although at different levels. Two areas in Detroit showed a pattern of sickness rates that differed substantially from each other, the rates in the high pollution area being generally at a higher level than those in the low pollution area. In other groups of households, results were inconclusive. Conclusion: more research needs to be done to establish relationship of air contamination in urban environment and sickness pattern and experience of people exposed to this contamination. Study was a project of the U.S. Public Health Service.

Pennsylvania Gets State-Wide Air Pollution Control Law

Legislation designed to give Pennsylvania statewide control of air pollution has been signed by Governor Lawrence. The act provides for a one-year study period before control standards can be adopted and enforced by an 11-man Air Pollution Control Commission.

Philadelphia and Allegheny County pollution control units will be permitted to operate as at present.

EXQUISITE ARCHITECTURE
by MINURO YAMASAKI
EXQUISITE COMFORT
by Marlo AIR CONDITIONING

A winter-summer climate control system incorporating Marlo Spray Type Dehumidifiers and Central Station Units provides round-the-calendar comfort for employees and visitors in this superbly-designed building — Reynolds Metals Company's new Great Lakes Region Headquarters.

General contractor for the project was Darin & Armstrong; Consulting engineer, Charles Whitney; Mechanical contractor, Green Plumbing and Heating, Inc.

Marlo coil co.

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Quality Air Conditioning and Heat Transfer Equipment Since 1925

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NEWS of the Industry

Air Pollution Control Association Convenes In Cincinnati, May 22-26

More than 400 air pollution control officials, research workers, and industrial representatives are expected to attend the 53rd annual national meeting of the Air Pollution Control Association May 22-26 at the Netherland-Hilton hotel in Cincinnati.

Program for the meeting, announced by Charles W. Gruber, conference chairman, will review all aspects of the nation's air pollution problems.

In all, 69 technical papers will be delivered in 18 sessions on specific air pollution problems. Industrial exhibits will be shown in an adjoining hall at the hotel.

Among the subjects to be dealt with during technical sessions are community air pollution surveys, auto exhaust research, industrial air pollution control, agricultural research, and zoning, planning, and administration for air pollution control programs.

One afternoon will be devoted to tours of industrial plants and research installations in the Cincinnati area doing outstanding work in air pollution control.

Requests for registration information should be addressed to "APCA Annual Meeting, 2400 Beekman St., Cincinnati."

To Air Condition Case Tech Library

Air conditioning equipment will play an important role in the new $2.5 million Library and Humanities Center at Case Institute of Technology in Cleveland.

Dr. Frederick L. Taft, director of libraries at Case, said an essential function of the air conditioning system will be to protect the library's collection of books, paintings, and musical recordings from mildew and warping.

The system will change inside air six times every hour.

In the installation made by Spohn Heating & Ventilating Co., a 250-ton water chiller provides cooling for a high velocity air handling system. Air distribution is through 153 under-window units.

Work of Incinerator Institute Hailed

Work of the Incinerator Institute of America in establishing new standards of incinerator design, and in advising communities on incinerator standards for better air pollution abatement, was hailed by public officials at the Chicago meeting of the Incinerator Institute of America.

Fred T. Mommsen, assistant director of air pollution control in Chicago, described the contribution incineration has made to air pollution abatement and lauded the contribution which the I.I.A. provides in helping to establish guides to preparation of rules and regulations governing installation and operation of incinerators.

The I.I.A. has also rendered assistance to New York City's Department of Air Pollution Control in the preparation of rules and regulations governing the installation of Class II incinerators.

From offices at 420 Lexington Ave., New York, under the direction of V. P. Gopcevic, executive secretary, research and technical bulletins are made available.

Officers of the association are: Richard Goder, president; Fred W. Donley, vice president; John A. Herbert, vice president.

* * *

Attending the quarterly meeting of the Incinerator Institute of America held in Chicago in January were: (Standing l. to r.) John Sved and H. W. Lincoln of Morse Boulger Destructor Co., Fred W. Donley of Donley Brothers Co., John A. Herbert, Washburn & Granger, Inc., and V. P. Gopcevic. (Seated l. to r.) E. M. Voelker of Nash, Cadmus & Voelker, Inc., Donald Koles of Pyro Incinerator & Supply Co., Hugh J. MacMillan of Burn-Zol Co., and Richard Goder, Joseph Goder, Inc.

(Please turn to page 20)

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☐ Industrial Bulletin 184-A

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Ruemelin Dust Filters collect and suppress dust created from all types of industrial applications. Available in single compartment or continuous multi-compartment units in capacities from 500 to 30,000 CFM.

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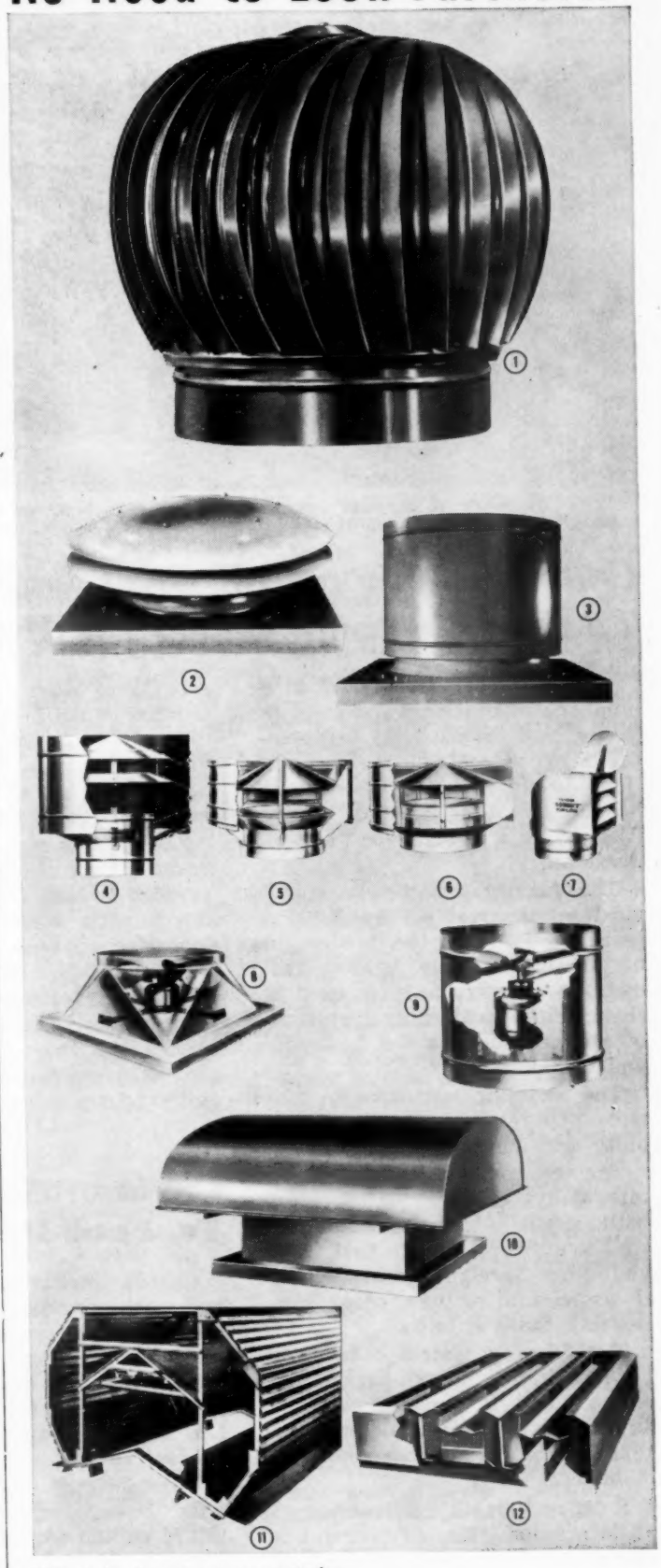

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NEWS of the Industry . . .

(Continued from page 16)

Clean as a hospital operating room, says General Electric.

Controlled Air at G-E Gives Longer Life To Key Electronic Tubes for Missiles

Key electronic tubes used in a number of operational and developmental missiles are being manufactured under controlled air conditions in an area as clean as a hospital operating room at General Electric Co.'s power tube plant in Scranton, Pa.

The facility, completely sealed off from the rest of the factory, is being used for the production of small, extremely light-weight, metal-ceramic triode tubes used in the guidance and control systems of missiles such as the LaCrosse and Corporal.

The exacting atmosphere controls will result in greater reliability and longer life operation.

The area, painted white to facilitate daily cleaning, is supplied with specially filtered and controlled air to keep out dust, lint, and other foreign matter which, if sealed into a tube, could conceivably cause it to fail.

The filtering system completely changes the air in the area every six minutes. It removes particles as small as 1/10 of a micron—less than 1/250,000 of an inch in diameter.

Relative humidity is maintained at 35 percent. Humidity control is essential because small amounts of moisture condensing on metal tube parts can cause rust, detectable only by microscopic examination. This can later result in tube failure.

Access to the area is through a double air lock. Production workers have their shoes vacuum brushed in the first air lock. Then they pass to the second where they change into lint-free smocks before entering a closed corridor leading to the work rooms.

The area is also pressurized so that any dust which penetrates the complex air-lock system will not be able to enter a work room when a door is opened.

Actually, the area is protected by still a third air lock, since the main assembly area, which surrounds the tube making facility, also exercises a lint and dust control program.

Carbon Monoxide To Fuel Boilers

Carbon monoxide from major non-automotive sources should be reduced substantially by 1961 under a voluntary program being carried out by Los Angeles Basin petroleum refineries, reports the Los Angeles County Air Pollution Control District.

Program calls for installation of huge waste heat boilers, which utilize carbon monoxide as fuel.

Three of the boilers, costing about $1.5 million each, are already in operation eliminating 1,060 tons per day. Plans for the final two units, scheduled for completion in 1961, show they will eliminate an additional 522 tons per day.

Engineering Group Fights 'Quacks'

Chicago Chapter of the Illinois Society of Professional Engineers, campaigning against so-called engineering "quacks," has asked Chicago's City Building Department to require all plans and specifications to be sealed with a professional engineer's seal.

The proposed requirement would apply to every plan for air conditioning, heating, and ventilating systems, including those for private residences.

The charge was made, in a press release issued by the Chicago Chapter, that the engineering profession "is being infiltrated by 'quacks' " who are "doing great harm to the public and to the profession."

The press release made a considerable point of the Franklin death case. This occurred last summer when two Evanston, Ill. residents died of carbon monoxide poisoning said to have been the result of a poorly ventilated home air conditioning system. The case was cited as an example of the type of installation which did not bear the seal of a professional engineer.

Representatives of the engineering group said they had been unable to see any top official of the City Building Department.

The engineers contend that no new law or ordinance is necessary to require the engineer's seal on plans and drawings. It can be done by an order from the department, they say.

Smog, Soot At Heart Of Urban Renewal

"The greatest force in driving people from the city to the suburbs was dirty air and industrial pollution—smog and soot."

So stated Carl Feiss, nationally known planning consultant from Washington, D.C., when addressing the Cleveland Chamber of Commerce and the Garden Center of Greater Cleveland.

Cleveland's air must be cleaned up before any attempt to renew downtown neighborhoods and buildings can be successful, said Feiss, a former Clevelander.

Atomic-Fired Boiler

Coming Sooner Than You May Think

Prediction that advances in miniaturization will bring the atomic-fired boiler to the smaller industrial, commercial, and institutional market sooner than many close to the field now believe, has been made by Russell E. Emrich, Sr., president and general manager of Boiler Engineering & Supply Co., Inc., Phoenixville, Pa.

Emrich feels that consideration of atomic energy as a boiler heat source now furnished by conventional fuels is not as visionary as it might seem. The custom-built atomic energy power plants being erected today all have central-station type heat exchange equipment designed by boiler manufacturers, it was pointed out.

"Boiler manufacturers are interested in three distinct avenues of approach to the use of atomic energy," Emrich observed.

"The first possibility is a vessel not unlike a present-day boiler in which the burner and furnace is replaced by a battery-like atomic charge.

"Because of the more highly developed central-station technology of atomic power generation, a second means of atomic energy utilization might be through replacing the burner and furnace of process and comfort heating boilers by some sort of electrical element in an electric boiler design.

"A third possibility is that heat from central atomic plants might be distributed much in the form of central district heating. Some sort of liquid-to-water heat exchanger will become the boiler of the future."

Recold Opens Ohio Plant To Serve East

Recold Corp. has begun air conditioning and refrigeration equipment manufacturing operations at new facilities in Columbus, Ohio. This new plant will supply the entire eastern seaboard, as well as some midwestern states. Recold's eastern warehousing facilities, opened two years ago, have also been moved to Columbus.

Construction will soon begin on a 50,000 sq. ft. addition to Recold's Los Angeles plant.

Control Program Urged for 2 Towns

Reporting on its first "emergency call" involving an air pollution situation, the Ohio Health Department urged the communities of Struthers and Campbell in Mahoning County to adopt a permanent control program.

There have been two occasions this year, the Health Department report stated, when air pollution in Struthers and Campbell reached such a condition that paint on a number of houses was discolored. No illnesses were reported.

Engineers who studied the situation said that evidence pointed to hydrogen sulphide gas from coke ovens at the Youngstown Sheet and Tube Co. as the likely cause of the pollution. Moist atmosphere would aggravate the situation, they added.

Because control activities must be established at the local level, the department's report suggests that the two neighboring communities set up a cooperative program because they have similar problems. It was recommended that an air pollution expert make thorough studies before any attempt is made to draft control legislation.

Meetings, Courses, Expositions

Stanford Research Institute symposium on chemical reactions in the lower and upper atmosphere, *Mark Hopkins hotel, San Francisco, April 18-20.*

U. S. Public Health Service course on "Analysis of Atmospheric Inorganics," *Robert A. Taft Sanitary Engineering Center, Cincinnati, April 25-29.*

American Society of Industrial Hygiene annual meeting, *War Memorial building, Rochester, N. Y., April 25-28.*

3rd Western Refrigeration, Air Conditioning, Heating, and Ventilating Exposition, *Shrine Exposition Hall, Los Angeles, April 27-30.*

Air-Conditioning and Refrigeration Institute annual meeting, *Hot Springs, Va., May 1-4.*

U. S. Public Health Service course on "Analysis of Atmospheric Organics," *Robert A. Taft Sanitary Engineering Center, Cincinnati, May 2-6.*

Instrument Society of America, second Instrument-Automation conference and exhibit, *Civic Auditorium and Brooks Hall, San Francisco, May 9-12.*

Postgraduate course in "Effects of Air Pollution and Environment on Health" for engineers, physicians, educators. *Wisconsin Center Bldg., University of Wisconsin, Madison, Wis., May 19-20.*

Industrial Heating Equipment Association, Inc., *The Homestead, Hot Springs, Va., May 22-25.*

Air Pollution Control Association 53rd annual meeting, *Netherland-Hilton hotel, Cincinnati, May 22-26.*

Design Engineering Show, *Coliseum, New York City, May 23-26.*

Institute of Boiler and Radiator Manufacturers annual meeting, *Seaview Country Club, Absecon, N. J., Week of June 6.*

American Society of Heating, Refrigerating & Air-Conditioning Engineers annual meeting, *Royal York hotel, Vancouver, B.C., Can., June 13-15.*

Engineering seminar on electrical precipitation in fly-ash and cement dust collection, *Pennsylvania State University, University Park, Pa., June 12-17.*

American Society for Testing Materials annual meeting, *Chalfonte-Haddon Hall hotel, Atlantic City, N. J., June 26-July 1.*

Engineering seminar on architectural and engineering planning aspects of atomic shelters, *Pennsylvania State University, University Park, Pa., July 10-22.*

Engineering seminar on structural engineering and radiation shielding aspects of atomic shelters, *Pennsylvania State University, University Park, Pa., July 24-Aug. 5.*

13th International Congress on Occupational Health. *Waldorf-Astoria hotel, New York City, July 25-29.*

American Chemical Society fall meeting, *Chicago, Sept. 3-8.*

Production Engineering Show, *Navy Pier, Chicago, Sept. 6-16.*

East Central Section, Air Pollution Control Association, *Sheraton-Cadillac Hotel, Detroit, Sept. 22-23.*

National Metal Exposition, *Philadelphia, Oct. 17-21.*

Institute of Boiler and Radiator Manufacturers semi-annual meeting, *Seaview Country Club, Absecon, N. J., Week of Oct. 31.*

Industrial Hygiene Foundation 25th annual meeting, *Mellon Institute, Pittsburgh, Oct. 26-27.*

Air-Conditioning and Refrigeration Institute annual meeting, *Hollywood Beach hotel, Hollywood Beach, Fla., Nov. 18-22.*

First Industrial Building Exposition & Congress, *Coliseum, New York City, Dec. 12-15.*

(Please turn to page 42)

This "Aluminum-Showcase" concrete waffle building has a . . .

Unique Heating-Cooling Installation In New Reynolds Metals Building

This hollow-core building has movable office partitions, a waffle shaped concrete slab construction, balcony offices, all of which posed many problems for system design engineers. This article also compares gas vs oil fuels, centrifugal vs absorption refrigeration machines.

by Edwin G. Siegel
Chief Mechanical Engineer
Minoru Yamasaki & Associates
Architects and Engineers

THE STRIKING NEW REYNOLDS METALS COMPANY'S Great Lakes Region Headquarters Building in Northwest Detroit is a real head-turner for passing traffic.

According to Architect Minoru Yamasaki, "Reynolds Metals Company wanted to produce a building which would focus attention of people in Detroit on the beauty and utility of aluminum. Since this building would be situated in the industrial and technological center of the country, it was felt by Reynolds that such a dramatization of aluminum in an exciting building would be valid here."

Essentially, the building design posed many problems when it came to designing the heating and air conditioning system.

The building (Fig. 1) is a three-story rectangle, placed on a podium, with an open first story lobby, with the second and third stories shielded by an aluminum grille. The skylight crowning the open central core gives finish and silhouette to the exterior skyline and floods the interior with daylight. However, this large, open skylight poses a downdraft problem in winter and a heat gain problem in summer. (See Fig. 2).

The sales area includes the whole first floor (Fig. 3) and consists of one large, undivided space where all types and sizes of aluminum products, even automobiles and boats, may be displayed. The only permanent occupant of this large display area is a receptionist, yet the cooling and heating system had to be flexible enough to handle all-season loads when groups of visitors crowd the display area.

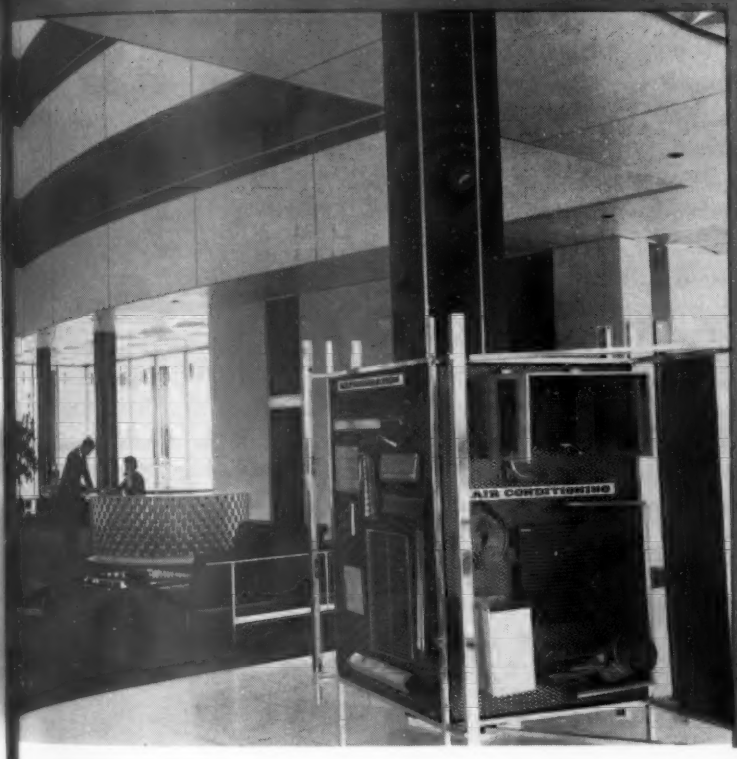
Office areas occupy completely the second and third floors. Since all office partitions are of the movable type, the air distribution and control system had to be designed for extreme flexibility for future changes in occupancy.

The basement contains a meeting and conference room, cafeteria and kitchen, miscellaneous offices, storage rooms and mechanical equipment room. Total building area is 45,500 sq. ft., including two office floors of 10,700 sq. ft. each. (Fig. 4).

Because the architect and owner desired to preserve the building roof silhouette unmarred by any exhaust fans or ducts, a novel ventilation and air conservation system was worked out for exhausting toilet areas, which will be described with the rest of the air distribution system below.

The only fixed, masonry partitions above the basement level are the walls which form the two service shafts. One shaft contains a stairwell, janitor's closets, three small exhaust ducts, chimneys, and return air shaft. The second shaft contains another

*About the Author: *Mr. Siegel is an Associate and Chief Mechanical Engineer with Minoru Yamasaki and Associates, and has been involved in the design of heating and air conditioning systems for over 18 years. He holds a mechanical engineering degree from the College of the City of New York, and has done post-graduate work at the Polytechnic Institute of Brooklyn, N. Y.*



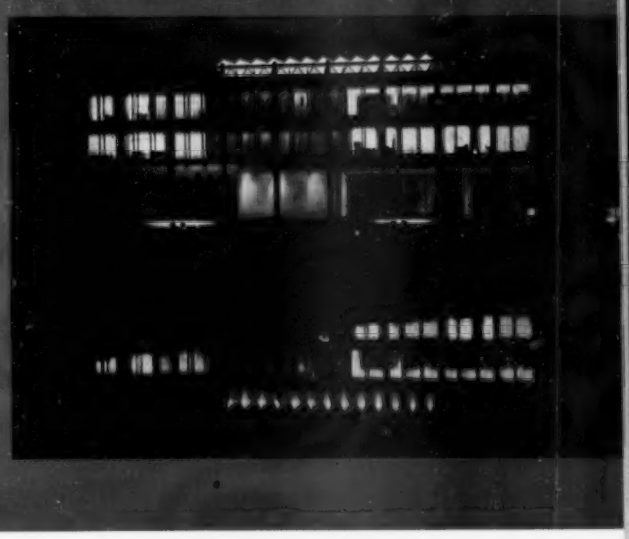


Fig. 1: Top left, *The new Great Lakes Regional headquarters building of Reynolds Metals Building, on a busy highway Northwest of Detroit, is a real head-turner for passing motorists. Building was designed to promote architectural and industrial uses of aluminum, through building itself and lobby display area.*

Fig. 2: Top right, *building, a three-story rectangle, has offices opening off balconies around periphery of interior open area. Skylight above, crowning open area, posed heating problem due to potential downdrafts. Note location of louvers in upper balcony walls, just under skylight, to combat downdraft.*

Fig. 3: Bottom left, *lobby is used for displays like the one shown here. Everything from boats to autos can be displayed in this large lobby area.*

Fig. 3A: Bottom right, *this dramatic night photo of the Reynolds Metals Building in Detroit highlights the striking beauty of this structure. Note the lighted skylight at top of building.*

stairwell, a hydraulic elevator and two return air shafts. The supply air risers are located inside of the return air shafts.

The structural slab forms a waffle pattern which is 5 ft. square, as shown in Fig. 5. The waffle serves as the lighting trough for the luminous ceiling. Vaulted sheet metal forms 3½ in. high are installed on the structural slab and serve to distribute the air supply to the exterior zones. A lightweight concrete fill above the sheet metal forms contains the underfloor electrical and telephone ducts.

The only furred ceiling space on the second and third floors are above 7 ft. wide corridors which are continuous around the open central core area. This integrated system reduces the floor-to-floor height

(Please turn to following page)

(Continued from preceding page)

to 11 ft. 3 in. and permits relocation of all movable office partitions without regard for lighting fixtures, ducts and supply diffusers.

The air distribution system for the sales and office floors is a dual duct design, consisting of a cool air duct, a warm air duct, and constant volume mixing boxes. Various alternate systems were analyzed, but had to be discarded as incompatible with the architectural design.

The walls are plate glass that extend floor to ceiling. This feature eliminated possibility of locating any type of mechanical equipment at windows. Overhead distribution through ceiling diffusers was neither practical nor compatible with the structural design. Isolation of noise between offices was another vital consideration. The dual duct system has proved to be the logical choice because it did not compromise the architectural design, it has permitted relocation of office partitions without impairing efficiency of the air conditioning system, and noise level is well below the design criterion as established by Bolt, Beranek and Newman, the consulting engineers on acoustics.

Major items of equipment for the dual duct system are located in the basement. The mechanical equipment room is L-shaped and comparatively long and narrow. Shape of the mechanical equipment room, locations of the air shafts, and the maximum duct diameters that could fit in the furred ceiling space on each floor made it necessary to utilize two supply fan systems.

One fan system supplies air to the zones along the north and west walls. The second fan system supplies air to the zones along the east and south walls. Combined capacity of the two fans is slightly greater than 40,000 cfm. Each fan discharges air through a sound attenuator. Leaving the attenuator, the air is blown through either a bank of steam distributing coils for heating or spray coils for cooling and dehumidification. Horizontal cool and warm air duct headers run at the basement ceiling and rise in the return air shafts.

The first floor is supplied by dual duct branches that connect to duct headers in the basement and extend around the periphery of the building and at the basement ceiling. Air is discharged through floor registers spaced on 10 ft. intervals. (Fig. 6).

Exterior zone on the second floor is 15 ft. deep and is supplied from horizontal branch ducts which are located in the first floor furred ceiling space that is continuous around the open central core area. (See Fig. 7.) Mixing boxes for the second floor exterior zone are also located in this furred ceiling space, (Fig. 8). A low velocity duct connects to the outlet of each mixing box, rises through the structural slab, extends horizontally on top of the structural slab, and connects to the air floor system. The underfloor duct is 3½ in. high, the same height as the sheet metal airfloor forms, and is insulated on top and sides in order to reduce radiant heat gain through the floor.

The underfloor duct passes beneath the interior zone which requires year-round cooling. Additional heat gain from the underfloor ducts, radiating into the interior zone during the winter, would have required a greater cooling capacity during the heating season than during the cooling season. The airfloor distributes the air to floor registers located at the window wall and spaced on 5 ft. centers.

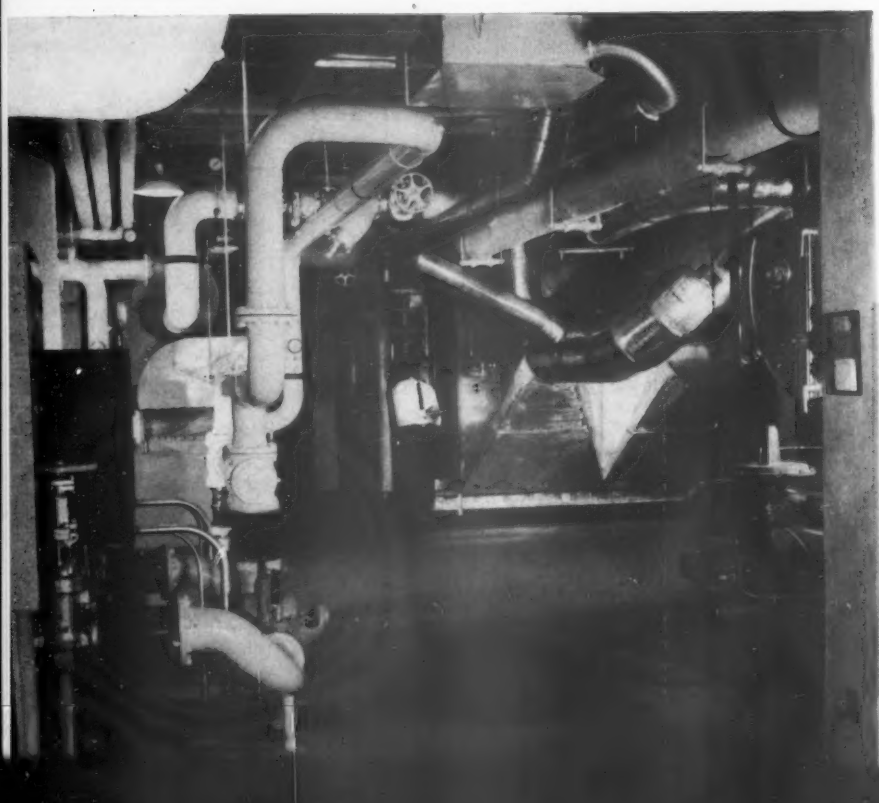


Fig. 4: *Mechanical equipment room. Left foreground, cooling tower pumps and piping. Left, rear, steam absorption refrigeration unit. Right foreground, gas burners and front of steam boiler. Rear center, to right of man (John Grimm, building superintendent) are two of the air handling units, supplying north and west sections of the building. Sprayed coil units are also in the air handling equipment. Note lavish use of aluminum in ductwork, duct insulation. Top center, mixing box supplies lobby registers.*

The exterior zone on the third floor and the interior zone on the second floor are supplied from common horizontal branch ducts and mixing boxes that are located in the second floor furred ceiling space. The manner in which the air is supplied to the third floor exterior zone is identical to the system as described for the second floor exterior zone. The second floor interior zone, which is 10 ft. deep and without dividing partitions, is supplied by high sidewall registers. Registers are connected to the mixing boxes with conventional, low velocity ducts lined with 1 in. acoustical insulation.

Interior zone on the third floor and the central core area are supplied from common horizontal branch ducts and mixing boxes that are located in the third floor furred ceiling space. The design employed for the two zones is identical to the one employed for the second floor interior zone. Air is supplied below the skylight of the central core area in order to counteract the cold downdrafts during the heating season and the solar heat gain during the cooling season.

Dual Duct System Velocity Limits

In designing the dual duct system, duct velocities were held within the following limits:

Headers and risers	*4,000 fpm maximum*
Branches on each floor	*3,000 fpm maximum*
Flexible ducts from branch to mixing box	*2,500 fpm maximum*
Underfloor ducts from mixing box to airfloor	*900 fpm maximum*

Underfloor ducts from mixing boxes to airfloor forms were not lined with acoustic insulation because the sheet metal forms were found to have inherent sound dampening qualities, thereby making acoustic lining unnecessary.

Return air registers with fusible link fire dampers are located on each floor and open into each one of the three return air shafts. Return air from exterior zones on the second and third floors are recirculated through door louvers or louvered sidelights into the interior zones which are open to the return air registers.

Some of the offices in the exterior zones required sound isolation for greater privacy. This was accomplished by means of acoustically lined transfer ducts which were sleeved through the waffle construction above the luminous ceiling.

The return air shafts connect to a poured concrete trench that runs below the basement floor and terminates in the return air fan plenum. The entire return air fan plenum is lined with 1 in. rigid acoustic insulation. The decision to install acoustic insulation in the return air plenum was justified when the difference in noise level in the building caused by the ventilation system was noted before and after the insulation was installed. The return air fan can return and/or exhaust the air in any proportion in accordance with the control sequence.

The outdoor air intake is located behind one of the service shafts. It is a horizontal grating installed level with the first floor. The second floor overhang protects the intake from weather.

Air Mixed In Concrete Trench

The exhaust grating is installed adjacent to the second service shaft, and it is similar to the outdoor air intake in design. Exhaust air from the return air fan is discharged into the mechanical equipment room for ventilation and is exhausted to outdoors through the exhaust grating.

Outdoor air is mixed with return air in a poured concrete trench located below the basement floor. The mixed air trench terminates in the floor and at the entering side of the filter bank. It was necessary to use return air and trenches below the basement floor because of the limited ceiling height in the basement, approximately 11 ft. clearance below beams.

A separate air conditioning system was installed for the basement rooms which include a meeting and conference room accommodating up to one hundred people, a cafeteria, kitchen and canteen rooms and miscellaneous offices. Conditioned air is supplied also to the basement corridor. Major components of equipment are located in the basement equipment room and include an outdoor and return air mixing plenum filter bank, air recovery cells, a vertical air conditioning unit with chilled water coil, and a steam distributing reheat coil for each zone. The reheat coil provides heating in the winter and reheat for temperature control in the summer. A separate basement air conditioning system was recommended because of the difference in occupancy from the upper floors.

The meeting and conference room may be scheduled for late evening use when upper floors are unoccupied. A substantial savings in operating costs would be realized if only the basement air conditioning unit need be operating during evening use. Another reason is that the higher density of occupancy resulted in a higher ratio of latent to total room cooling load. This condition indicated a need for reheat in an effort to control room relative humidity.

The complete building is air conditioned year round by all-air systems as described above with the exception of basement storage rooms and toilets. The storage rooms are heated by unit heaters and the basement toilets are heated by fully recessed convectors.

Aluminum was used to full advantage throughout the design of the heating and air conditioning systems. All high pressure and low velocity ducts with the exception of underfloor ducts and air floor forms were fabricated of aluminum. Other equipment fabricated of aluminum were the grilles, registers, and ceiling diffusers, thermostat covers, and convector

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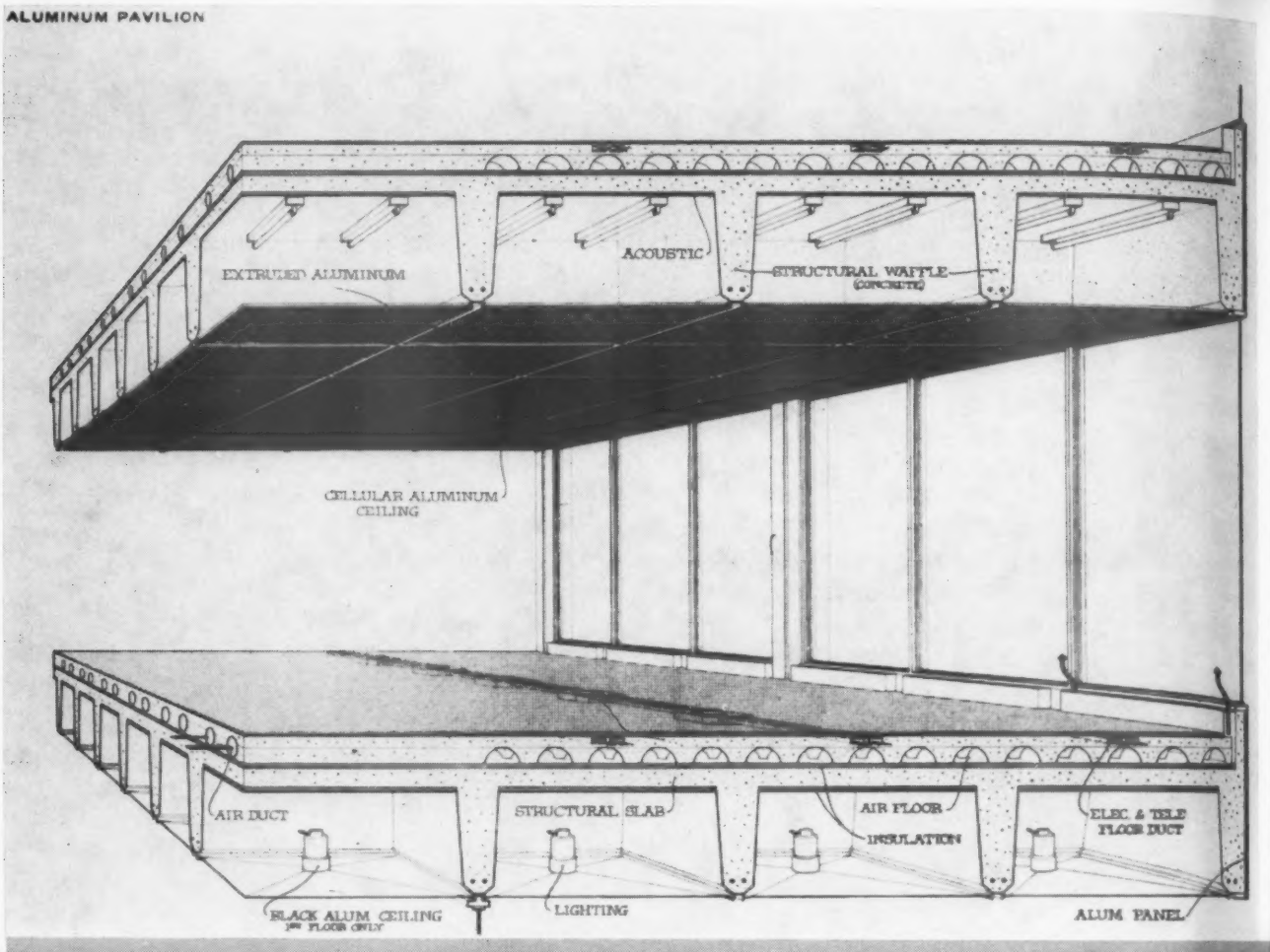

Fig. 5: *Section through building, showing waffle-shaped construction of floor, use of airfloor to distribute air, location of registers under windows.*

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front enclosures. Duct insulation was provided with a factory-attached, aluminum foil, reinforced facing.

The toilet exhaust was treated in a novel manner. An architectural design feature required that no fans or fan discharges be located on the roof, and spoil the clarity of the skylight silhouette. The following system was approved and incorporated into the building after much deliberation.

Toilet exhaust is ducted down to the basement equipment room, drawn through a casing containing a bank of air filters followed by a bank of carbon recovery cells, and discharged by a belted vent set into the electric substation. After ventilating the substation, the air is recirculated through the storage room, and, finally it is discharged from the building through a below-grade concrete pipe that terminates at a grade-level exhaust grating.

The design heating and ventilating load was estimated at 3,000,000 btu/hr. In order to determine which type of fuel for firing the steam boilers should be recommended, an economic analysis was prepared comparing the operating costs of burning natural gas and No. 5 fuel oil.

Yearly heating operating costs were based on the following assumptions:

Heating season – September 17 to June 2
Operating hours/season – 6200
Outdoor design temperature – 10F d.b.
Indoor design temperature – 74F d.b.
Equipment full time hours – 2045 (based on a seasonal load factor of 33 percent)
Average cost of No. 5 oil – $.10/gallon
Average cost of natural gas – $.80/1,000 cu. ft.
Maximum steam demand – 3100 lbs./hr.
Total steam requirements/heating season
= 3,100 lbs./hr × 2,045 hrs.
= 6,300,000 lbs.

Using natural gas @ 75 percent operating efficiency, cost of 1,000 lbs. steam = $1.04. Fuel cost/heating season = $6,570.

Using No. 5 oil @ 75 percent operating efficiency, cost of 1,000 lbs. steam = $.87. Fuel cost/heating season =$5,480.

Electrical costs for a No. 5 fuel oil burner were estimated as $30 higher than a gas burner.

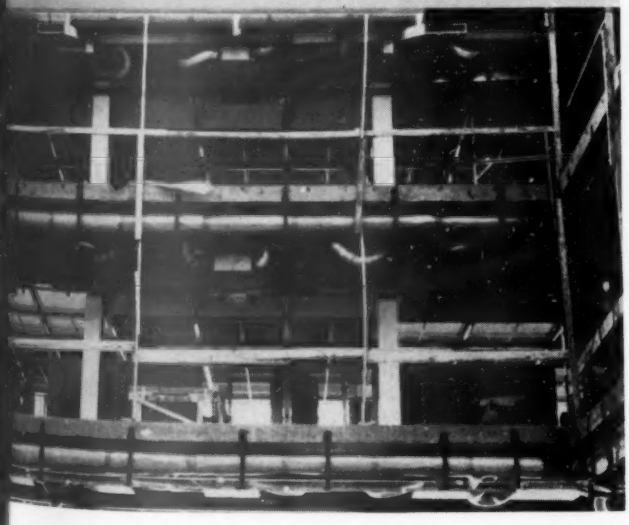
Initial cost of a fuel oil system was higher than a comparable natural gas system because of the higher cost of the burner, and added cost of oil storage, circulating system, and preheaters.

Based upon the above analysis, the owner requested installation of gas burning equipment.

The design cooling load was approximately 170 tons. A decision had to be made on the type of refrigeration machine to be specified for the chilled water system. The two machines considered were a hermetic centrifugal compressor and a steam absorption refrigeration machine. An economic analysis was prepared for each system before a recommendation was made to the owner. The analysis included initial and operating costs.

Based upon equipment prices available from the manufacturers, a steam absorption system would cost approximately $8,000 more than a hermetic centrifugal compressor system. However, there was a savings of approximately $5,000 in wiring, electrical distribution, transformers, switchgear, etc., when using a steam absorption machine.

Fig. 6: View from open court area in center of building, showing horizontal high pressure and high velocity ducts and mixing boxes installed in suspended ceilings of first, second and third floors.



Yearly cooling operating costs were based on the following assumptions:

Length of Cooling Season – May 1 to October 31
Operating hours/season – 1308
Seasonal load factor – 70 percent
Equivalent full time hours/season – 915
Average cost of natural gas – $.80/1,000 cu. ft.
Average cost of electrical energy – $.0223/kwhr.

Estimated horsepower requirements for a centrifugal compressor system, including compressor, cooling tower fan, condenser water pump and chilled water pump totalled 207 hp. The kw demand equalled 166 kwhr and the seasonal electrical energy consumption totalled 156,000 kwhr at a cost of $3400/cooling season. Adding cost of an annual maintenance service contract price of $980, the operating cost/cooling season for a centrifugal compressor system was estimated at $4380.

Estimated horsepower requirements for a steam absorption system including refrigeration machine, larger cooling tower fan and condenser water pump motors, chilled water pump, boiler-burner and condensate pump totalled 50.5 hp. Electrical energy cost/cooling season was estimated at $1135.00.

Fuel costs for the steam absorption machine were based on 75 percent boiler efficiency for a low pressure steam boiler with a gas-fired power burner. Maximum steam demand was estimated at 3500 lbs./hr or 3,200,000 lbs. steam-cooling season. With the cost of generating steam at $1.04/1,000 lbs., fuel costs/cooling season was estimated at $3340.

The annual maintenance service contract was estimated at $540.

Operating Costs $5015

Total operating cost for the steam absorption system, including, fuel, electrical energy, and maintenance was estimated at $5015.

Although estimates indicated that the hermetic refrigeration compressor would be cheaper to install and cost less to operate than the steam absorption refrigeration machine, the latter machine was selected because the salary for a licensed second-class refrigeration operator had to be added to the operating cost of a centrifugal compressor. The chief building inspector of the local township had requested that the owner comply with the ordinances of the City of Detroit which requires a licensed operator in attendance. When the annual wage of an operator, estimated at $10,000/year, was added to the operating cost of a centrifugal compressor, the steam absorption refrigeration machine proved to be more economical and was recommended to the owner.

Flexibility of the exterior office space on the second and third floors required a temperature control system of equal flexibility. During the late stages of construction, several of the office partitions were relocated at the owner's request. The air conditioning and temperature control systems were able to accommodate these changes without impairing system efficiency.

Compressed air piping to the thermostats for the exterior zones on the office floors was run in the

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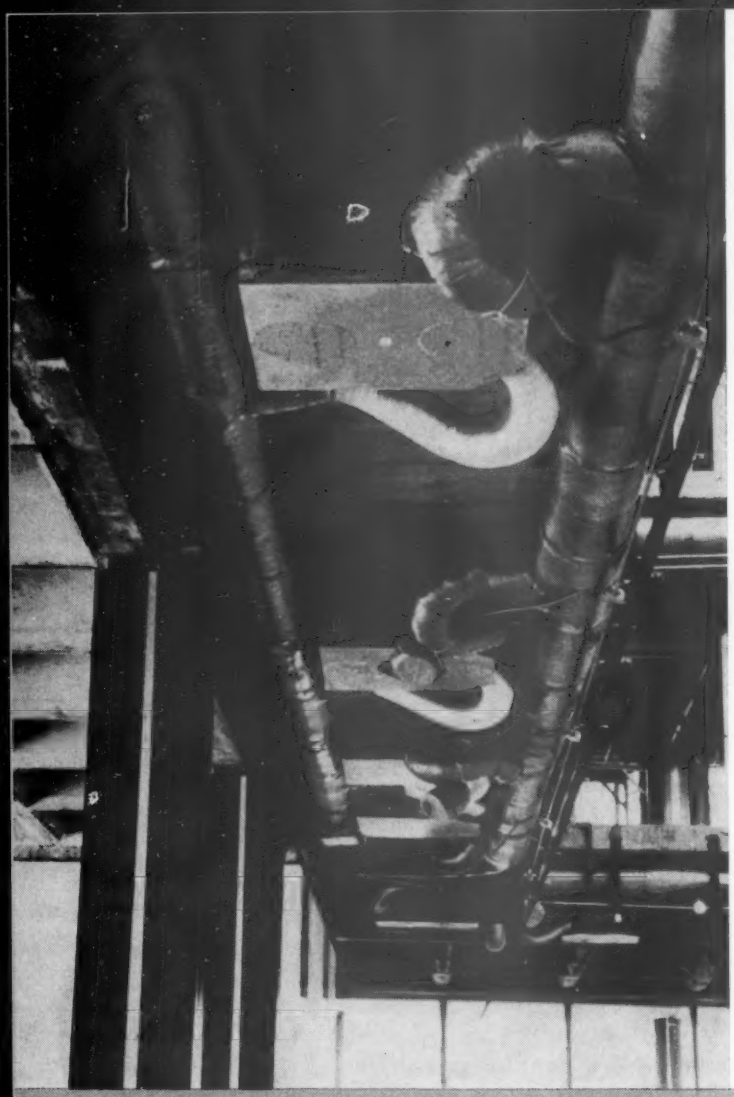

Fig. 7: *Typical high velocity ductwork and mixing boxes above suspended ceiling. Right edge of photo marks the open court area. The area under ductwork is peripheral corridor. Mixing boxes have top outlet.*

box. The regulator maintains a constant volume of supply air leaving the mixing box by repositioning the hot and cold dampers proportionally.

The system is switched from summer to winter control automatically by means of an outdoor thermostat. At outdoor temperatures below 55F the refrigeration system is inoperative. The mixture of outdoor and return air is maintained at 55F so that as outdoor temperature rises to 55F, percentage of outdoor air increases until it is 100 percent at 55F. At this outdoor temperature, the refrigeration system is placed in operation.

An automatic-manual switch permits manual starting of the refrigeration system. In either case, an electrical interlock prevents the refrigeration system from operating if either condenser water system, supply fans, or chilled water pumps are inoperative. As outdoor temperature continues to rise above 55F, percentage of outdoor air is decreased. At 65F, percentage of outdoor air reaches a minimum percentage. The fixed minimum percentage is adjustable manually.

Temperature in the cool air duct is maintained relatively constant year round at 55F. During the cooling season, a dew point thermostat controls a three-way valve in the chilled water piping to each cooling coil.

Temperature in the warm air duct is repositioned in accordance with outdoor temperature. It is at a

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Fig. 8: *Typical mixing box, supplying air to an interior zone. Note acoustical duct liner in low velocity duct outlet from mixing box. Worker is adjusting static pressure regulator with pressure gauge.*

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aluminum partition posts that supported the movable partitions. The control air line from the thermostat dropped down the aluminum post and through the floor, and connected to a manifolded control line. A needle valve is installed in the manifold between each two thermostat control lines. By opening and/or closing the needle valves, one or more thermostats can control the temperature in one, several, or all exterior rooms with a common exposure. Pipeheads for thermostats were installed in locations that may require individual room control in the future.

Each mixing box for the dual conduit system has two control air connections. One connection is for the control line from the room thermostat, and serves to position hot and cold air dampers in accordance with thermostat setting. The second air connection is a constant supply of air at 15 psi, and supplies air to a static pressure regulator mounted on the mixing

CONTROLLING AIRBORNE BACTERIA . . .

How Well Can It Be Done With Today's Air Sanitation Methods?

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Beginning an authoritative review of methods used to combat spread of disease by airborne droplets. Hospitals are on the front line, but these findings apply equally well to schools and other public buildings.

Fig. 1: *Flower Hospital, Toledo, Ohio reports spectacular results in the control of micro-organisms in delivery rooms and maternity section through use of a lithium chloride system. Research Foundation of University of Toledo took samples of 10 cu. ft. of leaving air at the unit and found no micro-organisms after 96 hours incubation. Similar samples of inlet air showed counts of 65 to 69. Photo courtesy of Surface Combustion, Div. of Midland-Ross Corp.*

RECENT WELL-PUBLICIZED epidemics of Staphylococcus aureus infections in hospitals have refocused attention upon the role of airborne bacteria in the spread of disease. Epidemics of this type are not new; a recent statistical study reported in the N. E. Journal of Medicine[1] demonstrated that although a reduction in the total number of fatal infections occurred during the period 1957-1958 as compared to 1938-1940, the incidence of staphylococcus infections, contrary to popular belief, was unchanged.

It is the persistence of Staphylococcus aureus epidemics in hospitals after most well-known infectious diseases have been brought under effective control by chemical drugs and antibiotics that gives them unusual prominence.

Every tissue and every organ of the human body is susceptible to invasion by Staphylococcus aureus (Micrococcus pyogenes, var. aureus) and it is among the most resistant of all bacteria. For example, when penicillin was first employed in the therapy of these infections, only a few strains were found with natural resistance. Less than ten years later, more than 50 percent of strains isolated from patients had a high degree of resistance[2] and this trend has continued to the present time. Therefore, treatment methods of staphylococcal infections are hardly more effective today than they were 20 years ago and this explains their unchanged status as a major hospital problem.

Spread of Infection

There are two ways in which infections spread: (1) by direct contact and (2) through the air.

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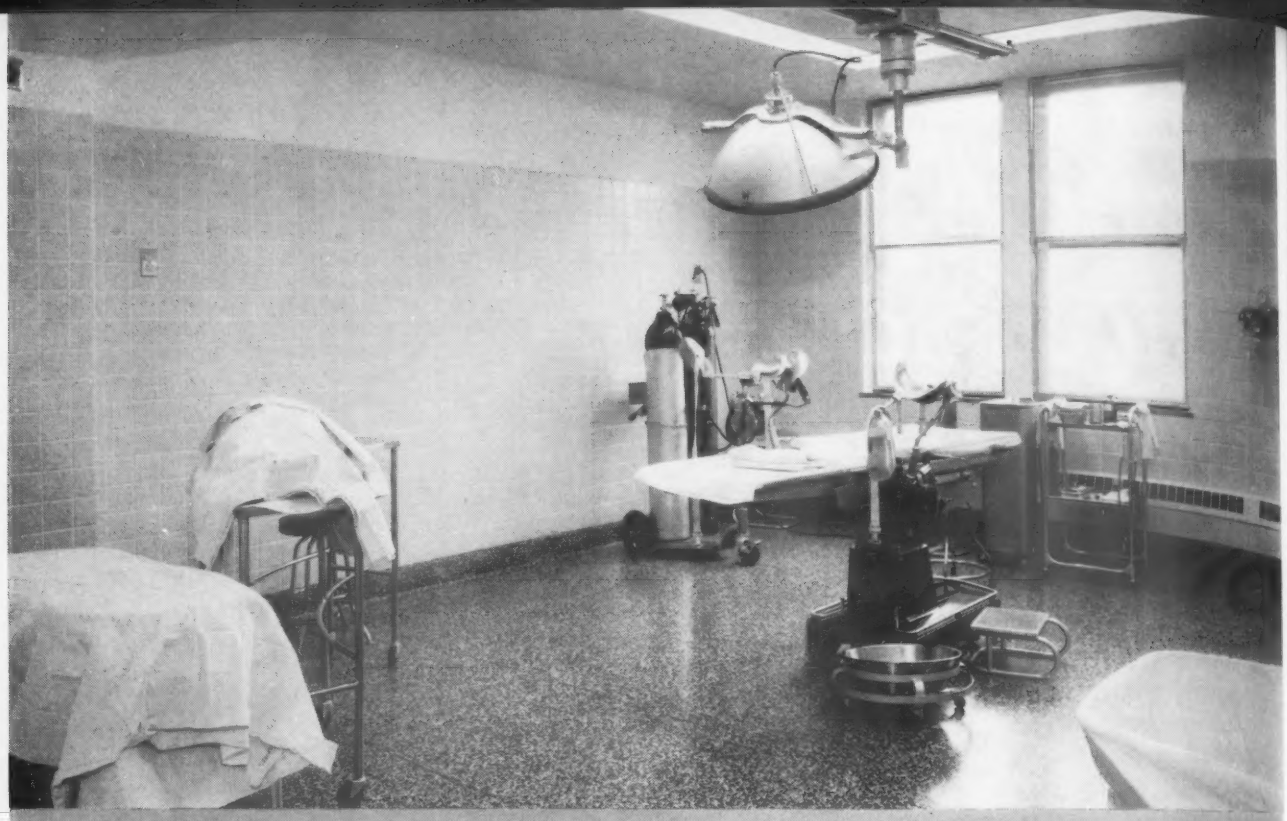

Fig. 2: *Air in these delivery rooms at Flower Hospital are chemically scrubbed to keep it below 10 micro-organisms per 10 cu. ft. as measured by the all-glass impinger method of collecting and counting. Not a single staphylococcus organism has been found in this air. Photo courtesy of Surface Combustion Div. of Midland-Ross Corp.*

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Transmission by direct contact occurs when there is a breakdown in the hospital's aseptic techniques as by failure to properly sterilize contaminated instruments, clothing and equipment before re-use and by inadequate cleansing of hands by attendants moving from patient to patient.

In addition, bacteria are constantly discharged into the air from the upper respiratory tract during talking, coughing and sneezing. When these droplets are projected directly onto another person, this is termed direct contact, also, even though the bacteria actually pass through the air for a very brief interval.

"Carriers", who may, themselves, be healthy, and resistant, are able to harbor disease-causing bacteria and transmit them to others. This is important because most commonly-used surgical masks provide only partial retention of nasal and oral discharges. Bacteria counts in operating rooms have shown that greatly increased numbers surround the garrulous surgeon as compared to the taciturn one.

Large droplets of bacteria-containing saliva and mucous from the upper respiratory tract which do not pass directly to another individual settle onto furniture and floor. Here, they dry out and leave bacteria attached to dust particles, lint and fine fibers. When this contaminated dust and dirt is stirred-up by cleaning, traffic, etc., it becomes airborne and carries adhering bacteria with it.

The smallest droplets do not settle but remain suspended in the air and lose their moisture very rapidly (often in a fraction of a second). The residues, often containing a single bacterium surrounded by a thin film of dehydrated saliva or mucous, are only a few microns in diameter and are called "droplet nuclei". They may remain suspended in air indefinitely, since normal room convection currents are greater than the still air settling velocity of these droplet nuclei.

Bacterial Survival and Viability

Tests have shown that many disease-producing bacteria, including Staphylococcus aureus, are capable of remaining viable (i.e. capable of growing and multiplying when innoculated into a suitable nutrient) for periods as long as 6-14 weeks when released in mucous or pus. Similar bacteria, unprotected in this manner, are killed in a few hours by the natural process of drying.

It is uncertain at the present time whether all bacteria, though viable, retain their capacity to produce disease after prolonged exposure to light and drying, which profoundly affect the metabolism of the bacterial cell.

Variability of bacterial virulence in response to changes in environment is a well recognized characteristic and naturally-occurring variations in virulence have been observed in the course of many epidemics. Use is made of this characteristic in the laboratory to produce active immunizing agents.

Evaluation of the virulence of airborne bacteria in hospitals remains a matter of great importance because resistance to disease of the occupants (infants, the elderly and the gravely-ill) is markedly below that of the general population. While this question is unanswered, it is not possible to reach sound conclusions on the relative importance of direct contact and airborne transmission in the spread of Staphylococcus aureus and other infectious agents in hospitals.

The weight of medical opinion now holds to the opinion that spread of disease by direct contact is more important. Nevertheless, in view of the uncertainty it seems reasonable to make every effort to control both modes of transmission in hospital wards and operating rooms. *As control of contact infection improves, the relative importance of airborne transmission will increase and greater demands will be made on the ventilation engineer to design facilities which are capable of establishing and maintaining sterile air conditions inside hospitals and other medical facilities.*

Air Sampling Methods

The use of different air sampling and culturing methods has made comparison and correlation of results between investigators exceedingly difficult. Early investigations were made by setting out uncovered dishes of sterile culture media and allowing bacteria to settle onto the nutrient surface. After incubation for 24-48 hours at 68F or 98.6F, the number of growing bacterial colonies was counted with the unaided eye or else under slight magnification.

However, the *quantity* of air from which these bacteria settled could never be determined to any satisfactory degree of certainty and, of course, only the bacteria adhering to the largest dust particles or those contained in the largest droplets settled onto the culture plates.

These deficiencies led to the development of improved sampling instruments. One, first described about twenty-five years ago, was the Air Centrifuge of Wells[3] which introduces a metered quantity of air into a spinning glass cylinder whose walls are lined with a layer of sterile culture medium. Centrifugal motion imparted to the air stream by the rapidly spinning cylinder causes dust particles and droplets to travel radially outward to the cylinder walls and adhere to the moist, sticky culture medium.

However, the centrifugal forces generated in the air stream are not of sufficient intensity to precipitate all the droplet nuclei. Liquid impingers, similar in design and operation to those used for dust sampling, have been widely used and they give the highest bacterial counts because (1) bacteria can be captured in specially-formulated preservative liquids and (2) clumps of airborne bacteria which count as only single colonies by most other sampling methods, are shattered and dispersed.

General Electric Company manufactures an electrostatic air sampler[4] which draws air over the surface of sterile culture dishes electrostatically charged to approximately 7000 volts. Operation depends upon the theory that all airborne micro-organisms carry a positive or negative electrical charge. Since only those of one polarity can be collected on a single dish (while those possessing the opposite polarity will escape), the apparatus holds two dishes charged to opposite polarities and the metered air stream is split evenly between the two. The total count is the sum of the bacteria collected on the two dishes. Collection efficiency is high for all airborne bacteria.

A simple apparatus much used for collecting airborne bacteria is direct screening of air through a thin cellulose membrane containing sub-micron sized pores and direct culturing of the bacteria caught on the filter surface by simple modifications of standard techniques[5]. Although simple and direct, viability of the trapped organisms declines as the sampling period is prolonged (probably due to ac-

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Fig. 3: *Hospital nurseries are another area where control of airborne bacteria is extremely important. Photo courtesy of Surface Combustion Div. of Midland-Ross Corp.*

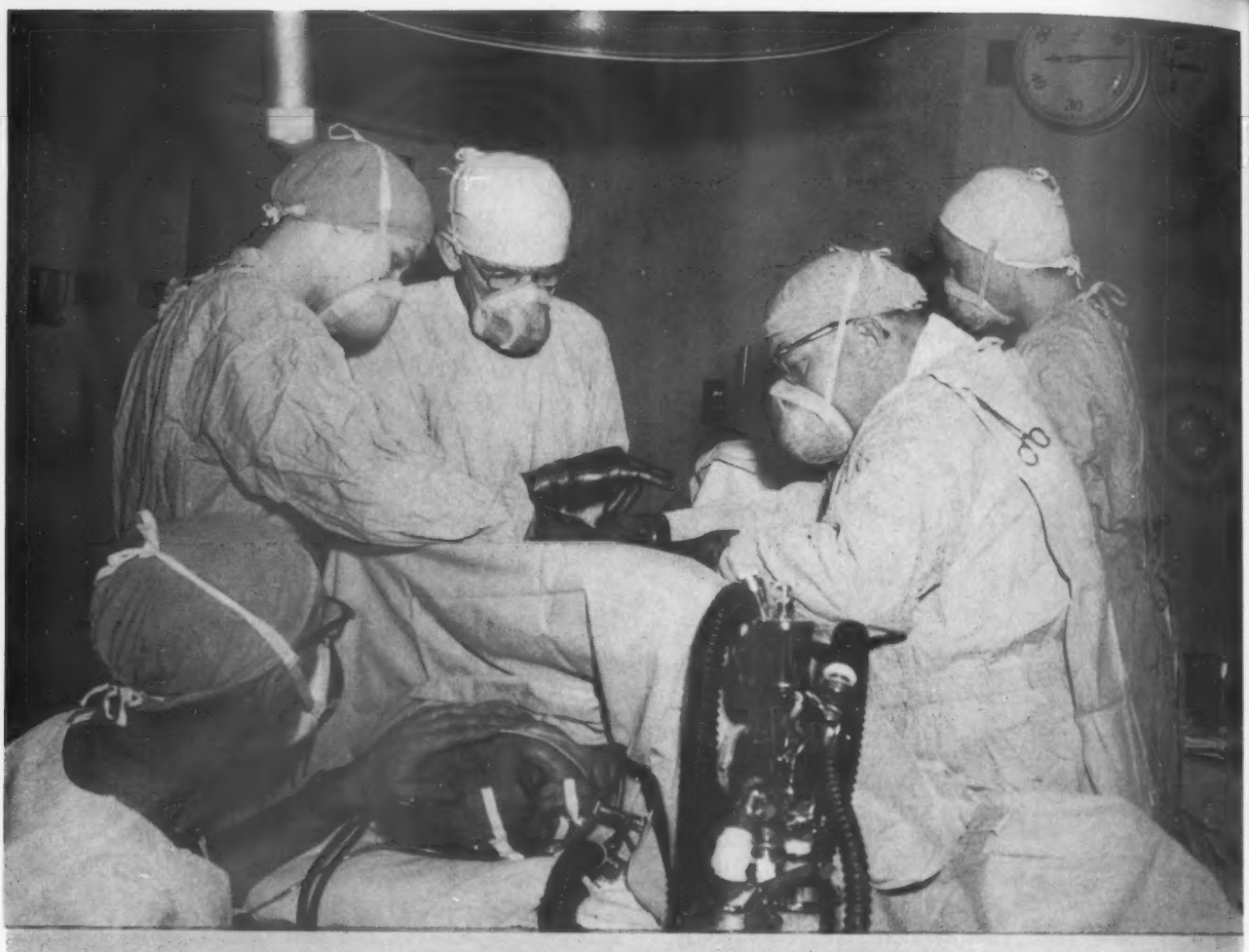

Fig. 4: ***Fitted filter mask pictured above is only one worn by operating personnel at Huggins Hospital, Wolfeboro, N. H. in nearly two years. It provides a functional efficiency of 95 to 98 percent, according to Dr. Ralph Adams of the hospital. Photo courtesy of Cambridge Filter Corp.***

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celerated desiccation under the influence of the relatively high air sampling velocity) so sampling periods and air rates must be severely limited to obtain maximum survival.

It has been observed that all the air sampling devices, with the exception of the settling method, lead to the same general conclusions when used to evaluate the sanitary quality of air and the effectiveness of air purification equipment.

Bacterial Content of Air

Outdoor air contains approximately 5-30 viable bacteria per cu. ft. of air near the earth's surface and bacteria have been found up to a height of at least 20,000 ft.[2]. Outdoor air rarely contains bacteria capable of causing disease in man due to the combined effects of desiccation and the ultraviolet radiations in sunlight. Bacteria do not multiply in the air.

Air inside hospitals contains reduced numbers of the same bacteria found in outdoor air (brought indoors by mechanical ventilation and by natural air infiltration) supplemented by relatively large numbers of bacteria discharged into the air by the occupants. Yaglou and Wilson[6], using the Wells Air Centrifuge, found that the bacterial content of room air rose 5 to 11-fold when the number of occupants increased from two to nine. The absolute counts were 6 to 17 bacteria per 10 cu. ft. of air when there were two occupants and 66 to 84 when there were nine occupants in a 1400 cu. ft. test room.

Methods of Air Sterilization

Air may be sterilized (or decontaminated of disease producing bacteria) (1) by killing airborne bacteria with a lethal ray or chemical (2) by removing bacteria from the air stream with air filters, washers and similar devices and (3) by a combination of the two methods. Sterilizing rays and chemicals have been most effective when used to decontaminate air in occupied spaces such as operating rooms; whereas air washers, filters, and similar devices have been found best for sterilizing ventila-

tion air streams prior to introduction into rooms.

Disease-producing bacteria which originate in the occupied space may be controlled by dilution with bacteria-free air or by maintaining a bactericidal atmosphere within the space. Descriptions of the most important of the methods used to remove or destroy airborne bacteria, as well as mention of methods to suppress their dispersion into the air, follow:

Radiant energy from a variety of sources is known to be lethal to bacteria but only ultraviolet radiations have been used to any extent for air sterilization in hospitals and schools. Ultraviolet lamps, emitting a large amount of energy in the lethal 2537A wave length range, may be used in air ducts to disinfect the incoming ventilation air and may be placed in the room itself to kill bacteria released by the occupants.

Ultraviolet light has been criticised as a relatively poor sterilizing agent for air because of its inability to penetrate dust particles which carry bacteria. In addition, these rays produce injury to skin and eyes and it is generally impractical to require the use of suitable personal protective clothing to make it possible to use these lamps continuously in such places as operating rooms. As an alternative, it has been suggested[7] that ultraviolet lights be switched on for 1-5 minutes between operations (when the operating room is unoccupied) to sterilize the air.

Addition of bactericidal chemicals to the air has been under study for several decades and large scale experiments were conducted at troop installations during World War II. Applications have been largely confined to the use of propylene glycol and triethylene glycol because the odor, toxicity or corrosiveness of other chemicals that might be used as air disinfectants makes them unsuitable. (The British experimented with chemicals which release chlorine into the air inside air raid shelters during World War II.)

The glycols, like ultraviolet light, have limited killing power in the presence of dust and, in addition, require air humidity between 20 and 50 percent for maximum lethal action. Continuous vaporization is needed to maintain effective room levels of 0.07 to 0.14 milligrams per liter for propylene glycol and 0.0045 milligrams per liter for triethylene glycol. Concentrations of this magnitude are apt to produce a slight glycol fog in the air of the treated space and, in time, all surfaces become coated with a gylcol film, which is highly objectionable.

Both ultraviolet light and glycols can be demonstrated to kill airborne bacteria but their ability to maintain continuous air disinfection in occupied rooms has not been universally confirmed in practical situations.

All the devices commonly used to remove dust from ventilation streams are effective, and to about the same degree, for removal of airborne bacteria.

An air washer tested by Yaglou and Wilson[6] was found to remove 66 percent of airborne bacteria when operated with sterile water – but only 23 percent when the water became contaminated due to return of organisms to the air stream by evaporation of contaminated spray water droplets. It was concluded that with steady operation the water could become so highly contaminated that bacterial count of the washed air would become higher than that of the untreated air.

Tests of large commercial air washers supplying an office building, a theatre and a pharmaceutical plant showed 70-80 percent bacteria-removal efficiency[8] but, in order to maintain this efficiency, it was necessary to add disinfectants to the wash water to inhibit growth of bacteria inside the equipment.

Tests of a commercial lithium chloride air dehumidifier[9] showed 97 percent bacterial efficiency. Growth of bacteria is inhibited in the lithium chloride solution and sterilization occurs when the lithium chloride is heated to regenerate its moisture absorbing properties. In view of the superior results reported for the lithium chloride unit, it should be pointed out that there is no reason to believe that lithium chloride solution is any more effective in removing bacteria from air than an equivalent amount of sterile water or strong brine; bacterial removal capability is a matter of washer design rather than composition of the washing liquid.

Next month, the author discusses practical means of controlling spread of airborne bacteria in hospitals by means of properly engineered air distribution systems and air sanitation equipment. ▲▲

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How to Balance Big Building Air Conditioning Systems

by Sidney A. Littmann
Chief Mechanical Engineer
Giffels and Rossetti,
Architects and Engineers

The best designed air conditioning system in big buildings will not assure owner satisfaction unless the system is properly balanced. This first of a series tells who should be responsible for system balancing and outlines various methods of balancing. Future articles will discuss balancing techniques.

Fig. 1: *Outlet velocity at coil face is being measured with air meter. Care should be taken in positioning probe to assure accurate readings. Photo courtesy Hastings Instrument Co., Inc.*

THERE IS NO SINGLE OMISSION in the design or installation of air conditioning systems, which has a more insidious effect upon the satisfactory performance of the system, than the omission of balancing. Although all the other features of the system may be perfect in every respect, if it is not balanced, it cannot be expected to produce desired results.

Many other features of the system may be poorly selected, conceived, or installed, yet the system may be so balanced as to achieve the end result of satisfactory space conditions.

Basically, balance of air (and water) flows to spaces served by the system is necessary if we are to maintain the various rooms at their designed conditions. As the effectiveness of air conditioning systems is dependent upon the product of flow and temperature differential, either or both of these independent variables must be so adjusted as to give a product corresponding to the loads created in the spaces to be controlled.

In general, the temperature control system is adequate for the control of temperatures, within the limits of the equipment installed. Consequently it is the balancing of flow rates which is of major importance. It is this feature with which this article will treat.

We need to balance air flows for a variety of reasons. Primarily, proper air flows are necessary to the maintenance of desired space temperatures. In some instances, the space humidity control is likewise dependent upon proper air quantities. Rates of flow to individual spaces must be maintained within proper limits, in order to avoid drafts.

Excess of exhaust over supply is required in certain spaces, such as kitchens and laboratories, in order to control migration of odors. Buildings are frequently maintained at a slight pressure above atmospheric, in order to prevent cold drafts when outside doors are opened, and to minimize infiltration. No one of these ends can be accomplished without reasonable balance of the air handling systems. For true owner satisfaction, then, system balancing is necessary.

The *owner* is interested in system balance, because he has paid for a system to achieve a particular purpose, which he will not get until balance has been achieved. He has a further interest, in that he may wish to make changes in the use of his property, which can frequently be accommodated by rebalance of the existing system rather than the installation of new facilities . . . if the rebalance is done competently.

Or, he may have changing needs during the construction period which can be satisfied by adjustments during the balancing procedure at the conclu-

(Please turn to page 37)

Fig. 2: *Measuring air velocity in duct with pitot tube and an inclined gauge. Photo courtesy F. W. Dwyer Mfg. Company.*

(Continued from page 34)

sion of construction. For all of these forms of relief, he generally turns to the *general contractor.*

The general contractor's interest in the proper balancing of the systems stems from the fact that customer satisfaction is dependent upon this step having been properly performed. Without balance, he is not able to demonstrate that the performance of the equipment conforms to the specification requirements. Usually, the general contractor depends upon the mechanical subcontractor for this work.

The mechanical subcontractor is interested in this subject for the same reasons as the general, and for other reasons as well. The balancing procedure is his primary means for assuring compliance with the intent of the design. During the time the system is operated for balancing, any essential equipment malfunction may be expected to show up, and may be corrected while he has his men on the job.

Should there be foreign material in the ductwork, excessively dirty filters, omitted dampers, or the like, they will be discovered and fixed. Any excessive vibration or pulsation can be found and suitable stiffeners provided, with no call-backs later. For the above reasons, many architects and engineers include balancing in the mechanical trades sections of their specifications.

The architect and engineer rely on the balancing in order to effect client satisfaction, to assure compliance with the design, and to discover any malfunction due to field conditions, so that appropriate action can be taken before the building(s) is (are) turned over to the owner.

The design of an air handling system is based upon the job requirements in cfm. These requirements may depend upon heating or cooling loads, ventilation requirements as stated in codes or by practice, necessity to control odors by dilution or direction of flow, need to maintain pressure differentials between

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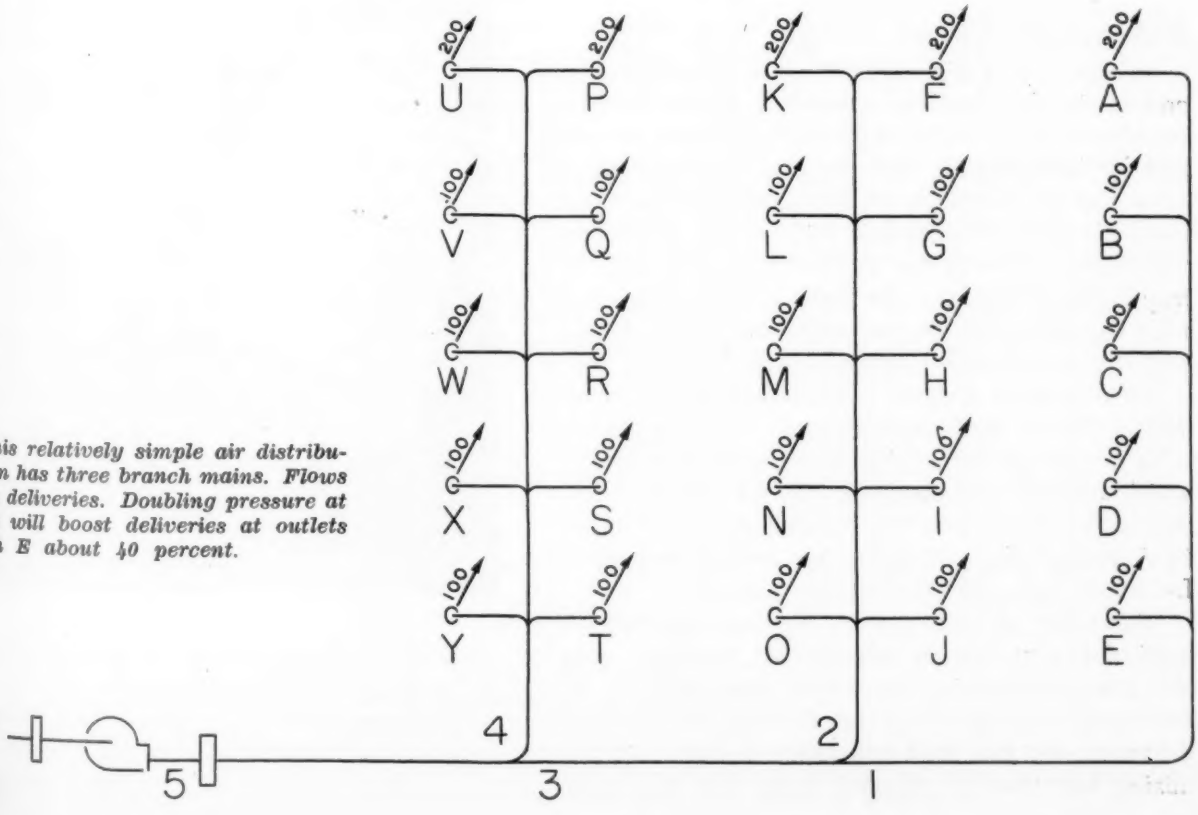


Fig. 3: *This relatively simple air distribution system has three branch mains. Flows are design deliveries. Doubling pressure at Point One will boost deliveries at outlets A through E about 40 percent.*

(Continued from preceding page)

parts of a building, or other considerations.

Provision is made in the design for the ultimate balancing of the system by some or all of the following:

1. *Balancing dampers*
2. *Adjustable splitters*
3. *Registers, grilles and diffusers having built-in volume control devices, either manual or automatic*
4. *Reserve capacity in air handling equipment*
5. *Special constant volume fittings*
6. *Pressure control of dual duct systems*

The inclusion of these facilities is required, and their extent dictated, by the extent to which imbalance of the system is inherent. System imbalance stems from necessary design compromise between economical duct sizing and low duct velocities. If branches close to the fan are sized to use the higher pressures extant there, then the velocities which result may be unacceptable because of the high noise levels which are associated with high velocities.

Conversely, if pressure drops in the branches nearest the fan are controlled solely by velocities in those branches which result in acceptable noise levels, then the remainder of the system becomes unreasonably large. If all the branch ducts were of the same (equivalent) length, use of the static pressure regain method of duct design would reduce the need for balancing devices, but at some increase in the size of the mains, and at considerable additional design cost.

High Velocity Systems

In the case of high velocity systems, where noise created in the ducts is attenuated in an acoustic chamber near the outlet, need for balancing is usually met by incorporating into the attenuation chamber some sort of automatic volume control based upon the static pressure existing in the chamber and necessary for overcoming the resistance downstream. It may be seen, then, that the techniques for balancing must depend, at least in part, upon the type of system, and the technique by which it was designed.

High velocity systems. As has been noted immediately above, these systems are usually provided with devices at the mixing boxes near each outlet, which automatically maintains either a constant pressure in the mixing box, or a constant velocity through it. A number of manufacturers can furnish such units, for either pneumatic or electronic control.

Balancing of high velocity systems requires no particular sequence of adjustment, provided only that the proper mixing boxes have been installed (so that capacity range of the unit includes the required delivery), and that field adjustment is built into the mixing box controls. In such cases, the only tools required are a screwdriver or special wrench to suit the control device furnished.

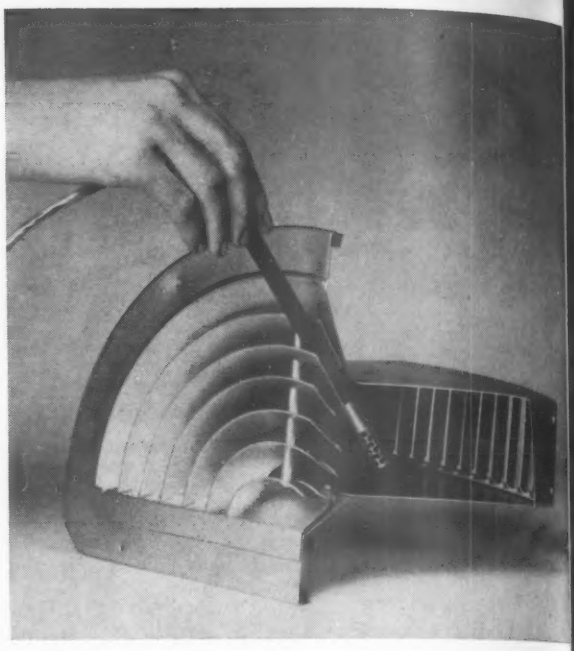


Fig. 4: *Probe of air meter is shown properly positioned to give accurate reading by Anemotherm from wall diffuser. Photo courtesy Anemostat Corporation of America.*

Fig. 5: *Measuring surface temperature of pipe with surface pyrometer. Photo courtesy Illinois Testing Laboratories, Inc.*

Systems operating at conventional pressures. Because the pressure drop required for the automatic

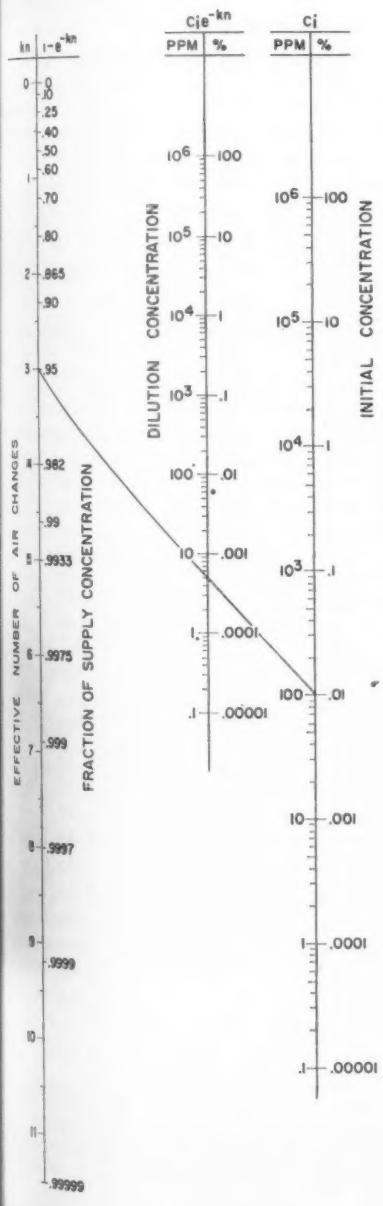
(Please turn to page 47)

Simple Way To Determine Air Contaminants

This simplified way to determine transient contaminant concentrations in the in-plant atmosphere will be of help in maintaining pure air for safe working conditions.

by Richard S. Brief
Medical Research Division
Esso Research and Engineering Co.

ALIGNMENT CHART FOR DETERMINING TRANSIENT CONCENTRATIONS



THE NUMBER OF AIR CHANGES necessary to render an enclosed, contaminated space suitable for entry may be calculated using an alignment chart which is described in this article. The rate of contaminant build-up may also be determined using this technique.

Actual measurement of the true contaminant concentration is, of course, the most desirable method of determining whether a space is safe for entry. However, the method described below will give a rapid estimate of the time required to reduce the contaminant concentration to an acceptable level. This method assumes that no additional contaminant will be released within the space during the time of dilution. When air analyses are being made, this technique will help to schedule sampling periods. In addition, use of this method might possibly limit exposure of persons doing the sampling.

The key to using this alignment chart is the number of air changes. For a particular space of known volume and known air flow rate, the number of air changes is simply (Equation I):

where:

$$n = \frac{Qt}{R} \qquad (1)$$

n = actual air changes, dimensionless
t = time elapsed, minutes
Q = air flow rate, cfm
R = room or space volume, cubic feet

Witheridge[1] has recommended air changes for various spaces for general ventilation. These are shown in Table 1 to give the order of magnitude that one might encounter in ventilation work.

Contaminant Dilution

If a space has an initial concentration of C_i, and air is continuously fed into the space, then the diluted concentration at any time will follow a logarithmic decay as shown in equation (2):

where: (2)

$C = C_i e^{-kn}$
C = concentration at time t, same units as C_i
C_i = initial concentration at arbitrary time $t = 0$
e = naperian logarithmic base, 2.7182818

(Please turn to following page)

TABLE 1

Recommended Air Change Rates for General Ventilation (from Witheridge[1])

Type of Space	*Air Changes/Hour (Low - High)*
Auditoriums; assembly halls	4 - 30
Boiler rooms; engine rooms	4 - 60
Corridors; hallways; lobbies	1 - 10
Foundries, ferrous	4 - 30
Foundries, nonferrous	6 - 60
Garages, storage and parking	3 - 20
Garages, repair	6 - 30
Hospitals, ordinary	2 - 15
Kitchens, commercial	10 - 60
Laboratories, chemical	6 - 30
Laundries; pressing shops	10 - 120
Machine shops	3 - 20
Offices, general and private	2 - 30
Residences (excluding kitchen)	1 - 6
Warehouses	1 - 6

It should be noted that even without forced ventilation, natural forces and traffic cause some air infiltration as shown in Table 2.

(Continued from preceding page)

n = actual air changes, dimensionless
(n = Qt/R from eq. (1))
k = mixing factor—described below, dimensionless
kn = effective air changes, dimensionless.

Perfect mixing is rarely accomplished so a mixing factor should normally be applied to the number of room air changes to approximate actual conditions. This mixing factor[3] will depend upon the vapor or gas toxicity, the uniformity of contaminant distribution within the room, location of the fans, construction of the room, and the population therein. This factor may vary from ⅓ to 1/10 and is used in conjunction with n to yield the effective number of air changes, kn. Thus, if the mixing factor for a particular room was ⅓ and the room had 9 actual air changes, then the room would have only 3 effective air changes.

Obviously, selection of the mixing factor for any particular room or space will be at best, an estimate. For an individual not particularly familiar with the efficiency of air mixing within enclosed spaces, the recommended procedure would be to use k = 1/10 to be on the safe side.

Naturally, the more accurately one can estimate the mixing factor, the more accurate the calculated concentration will be in relation to the actual concentration in the room after n air changes. The additional delay in entering a room because the mixing factor was incorrectly chosen on the safe lower side will be a justifiable safety measure.

Special Mixing Provided

If extensive efforts are made to insure complete and perfect mixing of room air and supply air (e.g., some calibration chambers) then the mixing factor, k, could conceivably be made to approach the value 1 and for practical purpose the value 1 could be used. The alignment chart column kn would then be read directly as the *actual* number of air changes, n.

Use of Chart

In using the accompanying alignment chart the effective number of room air changes (kn) on the left should be connected with the initial concentration value on the right (C_i). The diluted concentration ($C_i e^{-kn}$) at the time corresponding to the number of air changes would then be read directly from the middle line. Problem 1 below, as shown on the alignment chart, will describe this procedure in detail. Problem 2 shows how time can be brought into the calculations.

Problem 1:

Given 100 ppm methyl chloride in a space with an estimated mixing factor of 1/5, what is the concentration within the room after 15 air changes have elapsed?

Answer 1:

The effective air changes equals kn or 15 (⅕) = 3. Using 3 then as the effective number of air changes and 100 ppm as the initial concentration, the alignment chart example gives the diluted concentration as 5 ppm.

Problem 2:

A 100,000 cubic foot room contains 1,000 ppm benzene vapor. The ventilation system for the room can handle 50,000 cfm, and from general considerations a 1/10 mixing factor (k = 1/10) has been estimated. How long will it take to reduce the concentration to a safe level?

Answer 2:

Assume the vapor limit for a safe level is the Maximum Allowable Concentration[4] which for benzene is 25 ppm. Using the alignment chart with 1,000 ppm as initial concentration and 25 ppm as the diluted concentration, 3.7 effective air changes (kn) are seen to be necessary. Then from eq. (1)

where:

$$t = \frac{nR}{Q}$$

n = kn/k = 3.7 (1/10) = 37
t = 37(100,000 cubic feet)/ 50,000 cfm
t = 74 minutes are required

Preparation of Known Concentrations

Sometimes the situation occurs where there is a concentration of contaminant in the supply air. For example, the feeding of known concentrations to an exposure or calibration chamber to develop a known concentration. The concentration in the chamber is obtained in a similar manner using a slightly modified formula:

$$C = C_s(1 - e^{-kn}) + C_i e^{-kn} \quad (3)$$

where C_s is the concentration of contaminant in the supplied air. Other units are the same as noted previously. The units of C_i, C_s and C must all be consistent.

Again using the alignment chart the fraction of supply concentration ($1 - e^{-kn}$) in the chamber after kn effective air changes is read (at the point on the left line) directly opposite the number of ef-

TABLE 2

Air Change Rates Caused By Natural Forces and Traffic

Type of Space	*Air Changes/Hour (Low - High)*
Rooms, 1 side exposed[2]	1
Rooms, 2 sides exposed[2]	1½
Rooms, 3 sides exposed[2]	2
Rooms, 4 sides exposed[2]	2
Rooms with no windows or outside doors[2]	½ to ¾
Entrance Halls[2]	2 to 3
Bath Rooms[2]	2
Reception Halls[2]	2
Room with no windows or outside doors	½ to ¾
Narrow room, windows in long wall, inside door	¾ to 1
Narrow room, windows in short wall, inside door	½ to ¾
Square room, windows in one wall, inside door	1 to 1½
Room with windows in two walls, inside door	1½ to 2
Room with windows in three walls, inside door	2 to 2½
Office building lobby, swinging doors	2 to 6
Store or restaurant, many door openings per hour	3 to 5
Department store, swinging doors with vestibule	½ to 3
Factory building, modern tight construction, large floor area in proportion to wall area	¼ to 1
Factory building, conventional construction	½ to 3
Factory building, large window area, poor construction	2 to 6

[2]These values were obtained from the 1959 ASHAE Guide. The Guide suggests that for rooms with weatherstripped windows or storm sash, use ½ of these air change rates where applicable but never less than ½ air change per hour.

fective air changes. This fraction multiplied by the supply concentration is the concentration in the chamber caused by the contaminant in the supply. If the chamber had some initial concentration, C_i, there will be additional contaminant from this source.

Contribution of the initial concentration is obtained by connecting the initial concentration point on the alignment chart with the number of effective air changes as before and reading the concentration on the middle line. Sum of these values will then equal total concentration in the chamber as shown in Problem 3 below.

Problem 3:

An exposure chamber contains 50 ppm methyl chloride initially, and there is 100 ppm methyl chloride in the supplied air. The chamber is estimated to have mixing factor equal to 1. What is the concentration in the chamber after 3 air changes?

Answer 3:

Using kn = 3(1) = 3 effective air changes, the alignment chart gives the fraction of supply concentration at 0.95. Thus, 0.95(100) = 95 ppm in the chamber from the supply air. The contaminant remaining from the residual air is obtained from the chart by connecting kn = 3 on the left with C_i = 50 ppm on the right. The residual methyl chloride is then seen to equal 2.5 ppm. The answer to problem 3 is therefore the sum of these values which equals:

95 + 2.5 = 97.5 ppm

Note that if the initial concentration was zero (the chamber was filled with air initially), then the concentration is simply obtained by multiplying the fraction of supply concentration from the chart by the supply concentration. In Problem 3, if there was no methyl chloride in the chamber air initially, the concentration after 3 air changes would have been 95 ppm.

The principle of contaminant build-up can also be applied to a situation where there is an undesired contaminant in the supply to a room. Problem 4 below shows how such a situation can be evaluated.

Problem 4:

What is the time necessary to dilute a room having 1,000 ppm benzene to 25 ppm benzene using a 5 ppm benzene air supply? The room has a volume of 100,000 cubic feet and fans capable of delivering 50,000 cfm. A 1/10 mixing factor has been assumed.

Answer 4:

Equation (3) is used for this problem with n being the only unknown. Equation (3) is rearranged to get it in a form for direct solution with the alignment chart.

$$C = C_s\,(1\text{-}e^{-kn}) + C_1 e^{-kn} \quad (3)$$

$$C - C_s = (C_1 - C_s)e^{-kn} \quad (3a)$$

substituting values from the problem

$$25 - 5 = (1000 - 5)e^{-n/10}$$

$$20 = 995e^{-n/10}$$

This is the form for direct solution for diluted concentrations. From the alignment chart with an initial concentration entry of 995 ppm and diluted concentration of 20 ppm, 3.9 effective air changes are obtained.

Now from equation (1) the problem is solved:

$$t = \frac{nR}{Q}$$

where:

n = kn/k = 3.9/10 = 39

t = 39(100,000 cubic feet)/50,000 cfm

t = 78 minutes are necessary

Other Applications

The alignment chart described in this article has application in any system where the concept or logarithmic decay is valid such as in natural radioactive decay or in a constant overflow system.

Natural radioactive decay is defined by a logarithmic decay equation of the form $N = N_i e^{-\lambda t}$. Here problems may be solved with the alignment chart by simply substituting the following values for the chart headings shown:

Let:

C = N, the number of atoms at time t

$C_i = N_i$, the initial number of atoms at t = o

kn = λt, the radioactive constant multiplied by the time elapsed, dimensionless

Another system meeting the logarithmic decay formula is a constant overflow system in which a pure liquid or liquid containing dissolved or suspended material is continuously added to a tank which itself contains either the same pure liquid or the same liquid containing some of the same material being fed. The concentration of material in the tank at any time could be determined with the alignment chart by noting the similarity between air and liquid systems. In the case just described, the concentration terms C, C_s, and C_i would be the quantities of material in the liquid; the space or room volume, R, would be the tank volume; the air flow rate, Q, would be the liquid flow rate; the mixing factor, k, would be a liquid mixing factor; and the number of air changes, n, would be the number of liquid changes within the tank.

Acknowledgment

The author wishes to express his thanks to Mr. A. R. Jones of Esso Research and Engineering Company, Medical Research Division for his helpful suggestions in the preparation of this paper. ▲▲

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4. Ibid, 13-1.

New AEC Radioactive Levels

Question:

The U.S. Atomic Energy Commission, has, I understand, issued a revised series of values for levels of radioactivity in air. What are these values, what do they mean and how will they affect industrial and medical users of radioisotopes?

CLH, N.Y.

Answer:

On May 4, 1959, the United States Atomic Energy Commission informed their AEC licensees of their proposed amendment to 10 CFR part 20 "Standards for Protection against Radiation." This amendment gives new values for maximum permissible concentrations of radioisotopes in air and water.

The principal difference between the values set forth in the proposed new tables and the regulations of January, 1957, are a reduction to 1/3 of the permissible concentrations of those radioisotopes having their principal effect upon the gonads or the whole body (i.e., those as to which the "whole body" or gonads are considered to be the critical organ) and the lowering of others to control the exposure in the gastro-intestinal tract to 0.3 rem/week.*

The proposed amendment include a comprehensive revision of tables of radioactive materials for their permissible concentrations in air and water above natural background. These new values are

(Please turn to page 51)

NEWS of the Industry . . .

(Continued from page 21)

Show Hydrocarbon Geiger Counter

An instrument that can analyze polluted air—indoors or out of doors—has been demonstrated by the American Cyanamid Corp.

Company researchers said the instrument measures total amount of hydrocarbons in atmosphere or in automobile exhaust gas. It will detect concentrations of hydrocarbons as low as 10 parts in a billion. But it does not respond to carbon dioxide or carbon monoxide.

The device was described as an improved flame ionization continuous analyzer, or a hydrocarbon "Geiger counter." It can separate and measure the various types of hydrocarbons such as olefins and paraffins.

The instrument weighs less than 25 lbs. and is portable, said Dr. William B. Ines, a laboratory research associate. He declared the instrument would be manufactured within a year by an outside company and would sell for under $500.

Stop Car Fumes, or U. S. Will, AMA Told

In hearings before the U.S. House of Representatives Health and Safety Subcommittee, U.S. Health and Welfare Department Secretary Arthur Flemming hinted that unless the auto industry takes positive action on eliminating exhaust and fumes from the air, the executive and legislative branches might combine to force action.

Flemming told the subcommittee he had understood that the industry proposed to make exhaust control devices available only on cars destined for delivery to California.

"I can't understand why all sections of the country should not have the benefit of such a device," the cabinet officer said.

While the Federal government is not about to bar, at this time, autos having noxious exhaust above fixed limits, "if there is no voluntary response, then Congress can do nothing but impose sanctions," Flemming stated.

A representative of the Automobile Manufacturers Association had testified previously that while "good progress" has been made by the auto industry in developing effective exhaust control devices, the industry will avoid "broad and sweeping solutions" because of widely differing pollution conditions.

"We believe that each community should be studied carefully in order to establish its specific requirements," said Karl M. Richards, speaking for the AMA. "Efforts to make available a device for all areas would only invite failure and would be unfair to the public."

El Paso Heads for Control Program

Following a two-year study of air pollution in the El Paso, Texas area, J. Harold Tillman, sanitary engineer for the City-County Health Unit, announced the unit will request City Council and Commissioners' Court to establish a $32,600 air pollution control program there.

The report said an effective air pollution control program will require an additional staff of four people. It should include an engineer to administer the program under the chief engineer of the health unit, with a junior engineer, a chemist, and a clerk-stenographer.

Major problems are dust and smoke, Tillman said. There is dust from quarry and cement operations and from traffic on unpaved streets, and odor problems from oil refining.

Wanson To Make, Sell Belgian Air Heater

The Wanson Corp. has been incorporated in Lewiston, Pa. to manufacture and sell "Thermobloc" industrial and commercial warm air heaters, under license from Establishments Wanson, of Brussels, Belgium. The Belgian firm lays claim to being the world's largest producer of warm air heating equipment.

The new company is headed by Harry L. Siegel, president, G. Clifford Rice, vice president, and Stanley H. Siegel, secretary.

"Thermobloc" heaters have been fabricated in Lewistown for the past three years, by an affiliate of the new corporation, but were sold by a Connecticut firm.

Pollution Complaint$

Tampa, Fla.—Moved to Federal Court jurisdiction, a suit against U.S. Phosphoric Products, Gibsonville, Fla., by 35 Ruskin, Fla., tomato and gladiolus growers. Suit alleges damages to plant growth caused by fumes from this phosphate processing plant.

Florida State Air Pollution Control Commission has warned that it would take legal action against phosphate plants generally if steps are not taken to curb pollution of air. Commission stated pollution from firms located in Hamilton and Polk counties is severe, and their cooperation poor.

• • •

Wilmington, Del. — Odors from Tidewater Oil Company's refinery near Delaware City are subject of landowner's group request to Court of Chancery. Former U.S. Senator Daniel O. Hastings, senior partner in firm of Hastings, Taylor and Willard, filed the action. Among the complainants are former U.S. Senator and Governor C. Douglass Buck and Mr. and Mrs. Felix duPont, Jr. Court was asked to appoint a special jury to whiff the "noxious, disgusting, malodorous and offensive Tidewater Oil Company refinery stench which invades and engulfs the dwelling houses of the plaintiffs, rendering customary use impossible."

• • •

Albany, Ore. — Against city of Lebanon, Ore., injunction filed by area residents against city dump, as a source of smoke, odors, disease.

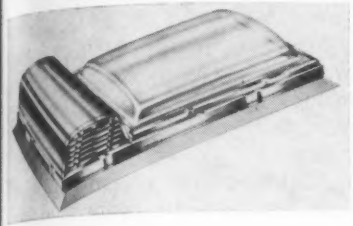
• • •

Marion, Ohio—For air pollution violations allegedly made by Republic Steel Corp., Councilman Ralph Perk has filed a resolution asking City Council to condemn as a nuisance a battery of old coke ovens at the plant.

Also in Marion, Darling and Co., a rendering plant, has promised a major "break-through" in controlling odors emitted from the plant. "As soon as equipment is installed, we anticipate more than 90 percent of the Darling plant odors will be eliminated," said Albert W. Locuoco, chief of the city's Bureau of Industrial Nuisances.

To be used in the Darling plant . . . a chemical masking agent with fans. Cost, said to be around $45,000.

New PRODUCTS



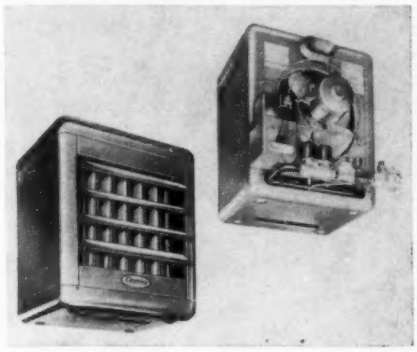
Skylight Ventilator

Purpose: Dual purpose unit for heavy-duty commercial, institutional, and industrial requirements.

Features: Astro-Vent integrates lighting and ventilation into one design. Both skylight and ventilator mounted on single extruded aluminum frame which fastens to self-flashing, insulated curb. Can be installed in rooms where noise suppression is critical factor. Integral back draft damper is mounted inside, out of weather.

Available in 1,350 variations with air moving capacities ranging from 180 to 4,400 cfm.

Source: Jenn-Air Products Co., Inc., Dept. AE, 1102 Stadium Dr., Indianapolis, Ind.



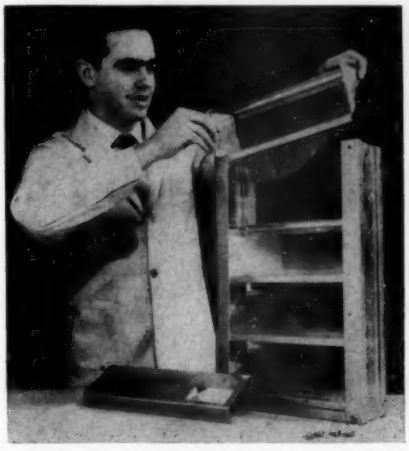
Gas-Fired Unit Heaters

Purpose: Provides two-stage heat in small offices and stores.

Features: Unit heater is fully automatic, two stage, propeller type developed to cut operating costs and eliminate annoying sudden blasts.

Operation begins at low heat output and fan speed and is maintained at this condition until more capacity is needed. When the need arises, thermostat automatically shifts to high heat output and fan speed.

Source: Carrier Corp., Dept. AE, Syracuse 1, N. Y.



Adjustable Aluminum Ventilating Louvers

Purpose: To admit air through exterior walls.

Features: Blades are interchangeable and easily installed. Louvers are constructed of 0.063 in. aluminum sheet and available in standard sizes ranging up to 12 ft. height and 5 ft. width.

Source: Walcon Corp., Dept. AE, Ecorse 29, Mich.

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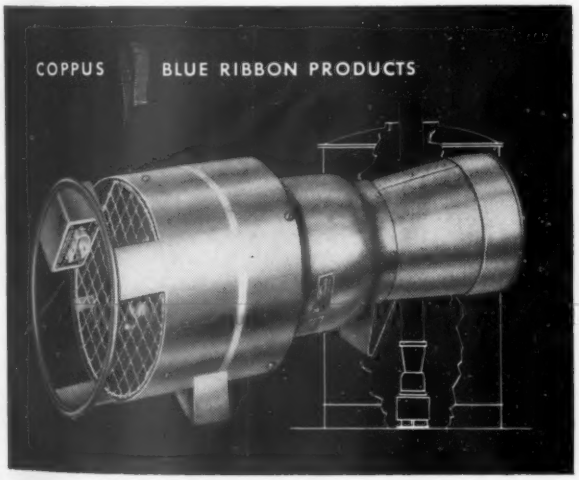

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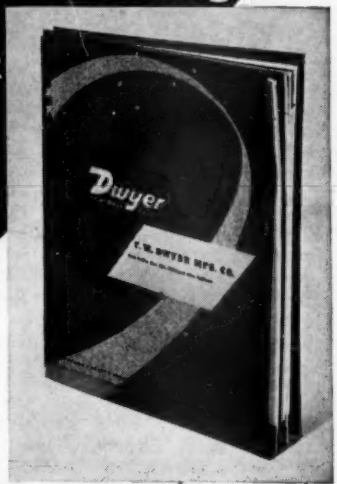

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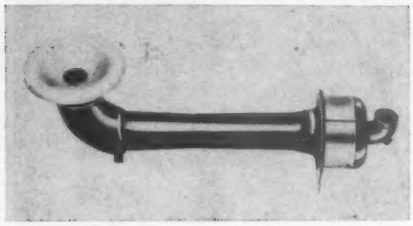


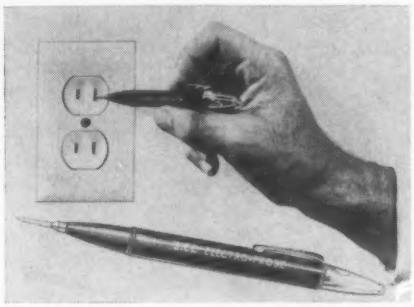
Venturi Burners

Purpose: For OEM use in furnaces, boilers, and hot water heaters.

Features: Of all steel construction, stamped, and welded for light weight, inshot and upshot venturi burners keep flame low in chamber and provide quiet operation. Models are available for dual fuels, various lengths, different spreader heights, and flame spreader shapes.

Sizes range from 5,000 to 400,000 input Btu depending on specific application.

Source: The Barber Mfg. Co., Dept. AE, 1052 E. 134th St., Cleveland 10, Ohio.



Portable Electric Current Tester

Purpose: Test current source.

Features: Small, handy tester locates current carrying wires by direct contact. If outlet, appliance, or switch is live, tester lights up. Tests from 110 to 550 volts, ac or dc. Price $1, postpaid.

Source: The Hahn Co., Dept. AE, 2311 Fox Hills Drive, Los Angeles 64, Calif.

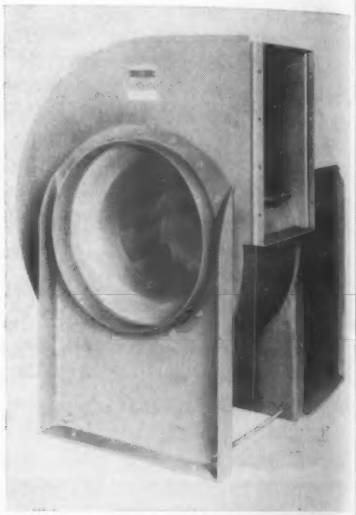
Bi-Metal Dial Thermometer

Purpose: Indicating temperatures in boiler or process applications.

Features: Thermometer is precisely calibrated with specially designed anti-parallax scale, all stainless steel construction, and welded joints. Accuracy to 1 percent is claimed by the manufacturer.

Dial sizes are available in 3 and 5 in., with ½ in. connection, stem lengths from 2½ to 24 in. All standard ranges are available from -40/120 F to 200/1000 F.

Source: Weksler Instrument Corp., Dept. AE, 195 E. Merrick Rd., Freeport, L.I., N.Y.



Centrifugal Ventilators

Purpose: Removing air in applications with low and medium ranges of volume and pressure.

Features: Util-A-Set centrifugal ventilators have motor and fan bearings mounted on rubber isolation rails eliminating vibration and resonant noise, resulting in extremely quiet operation.

Backward blade or forward curved wheels are available to meet requirements. Twelve sizes provide capacity range from 688 to 23,000 cfm.

Source: Ilg Electric Ventilating Co., Dept. AE, 2850 N. Pulaski Rd., Chicago 41, Ill.

Use Communications Center, page 35, for requesting more information about articles, advertised products, literature, and for comments about any of the editorial material in this issue of AIR ENGINEERING.

If you wish to contact manufacturers directly, street addresses are given. But please mention you saw it in AIR ENGINEERING.

in laying out your client's plant

ARE YOU GUARDING AGAINST DUST DAMAGE TO MACHINES?

Will there be dust-producing machines in your client's new plant? Such as metalworking, wood-working or penumatic conveying equipment? If so, you should plan now for dust control.

Because dust clogs and gums up costly machinery, lowers production efficiency, causes breakdowns and higher maintenance costs. In addition, dust is harmful to the health of employees.

More and more professional men, laying out new plants and remodeling older ones, are specifying Torit Dust Collectors. Torit Dust Collectors have proved 98% efficient in removing dust. They are compact, easy to install and maintain, and cost far less than many types of dust collecting equipment.

Contact a Torit representative. He will give you dust collector specifications, performance charts, dimensional drawings, installation suggestions . . . all the information you need.

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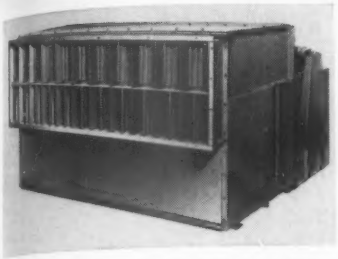
1133 Rankin St., St. Paul 16, Minn., Dept. 1927

Cyclone model. *Also available in portable cabinet models.*



Central Station Air Handling Units

Purpose: Broader use in multi-story, multi-zone air conditioning systems.

Features: Reduced over-all unit dimensions and greater number of arrangements and capacities. Trane Climate Changers now available in 14 sizes with three to 63 sq. ft. of coil area, 1,200 to 47,000 cfm capacities.

Incorporates new high capacity Sigma-Flo coils of wavy fin design to increase air turbulence within coil. Sectional design permits selection of components to meet any air conditioning requirement. Can supply up to 14 zones with independent air conditions.

Source: The Trane Co., Dept. AE, La Crosse, Wis.

Re-designed Casella Cascade Impactor

Purpose: Collect and grade dust samples.

Features: Contains four jets in series to collect airborne particles from ½ micron to 200 microns. Adhesive coated discs in each jet collect the particles in decreasing sizes. Instrument has demountable jets for easy cleaning.

Low velocities permit collection of large size dust samples without error.

Source: Mine Safety Appliances Co., Dept. AE, 201 N. Braddock Ave., Pittsburgh 8, Pa.

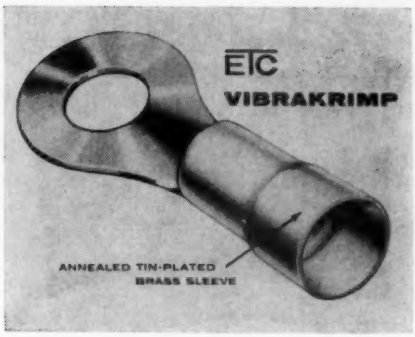
New Size Air Filter Holder Adapter

Purpose: For use in high-volume air sampler to collect larger samples of air.

Features: Adapters are used with the high-volume air sampler manufactured by Staplex to collect larger quantities of air for testing in shorter length of time.

Filter holder adapters range in sizes from 6 by 9 in. to 12 by 12 in. They are capable of measuring particulate matter as small as 1/100th of a micron in diameter both indoors and out.

Source: The Staplex Co., Dept. AE, 777 Fifth Ave., Brooklyn, N. Y.



Vibration Resistant Terminals

Purpose: For use where excessive vibration is encountered.

Features: Vibrakrimp solderless electrical terminals are strengthened by seamless, annealed, tin-plated brass sleeve permanently attached over regular terminal barrel.

Skirt of sleeve extends beyond barrel and is crimped with barrel to grip wire insulation permanently, preventing creep.

Terminals come in all tongue types, all standard stud sizes, and basic dimensions.

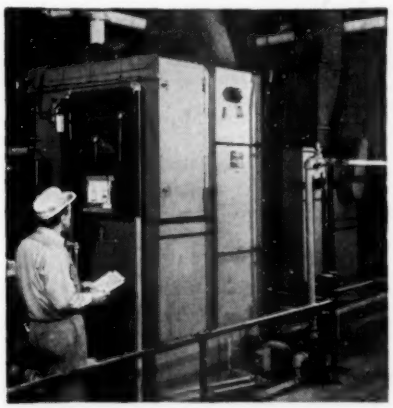
Source: ETC Inc., Dept. AE, 990 E. 67th St., Cleveland 3, Ohio.

(Please turn to following page)

DRY and CLEAN AIR at the RIGHT TEMPERATURE

- to control your product quality
- to protect a critical operation
- to protect apparatus from moisture damage
- to DRY your material or product
- to control packing or storage conditions
- to assure precision in testing or research
- to increase air conditioning capacity

Air Condition by the NIAGARA Method Using HYGROL Liquid Absorbent



This compact method, giving high capacity in small space, removes moisture from air by contact with a liquid in a small spray chamber. The liquid spray contact temperature and the absorbent concentration, factors that are easily and positively controlled, determine exactly the amount of moisture remaining in the air.

Most effective because... it removes moisture as a separate function from cooling or heating and so gives a precise result, and always. Niagara machines using liquid contact means of drying air have given over 20 years of service. The apparatus is simple, parts are accessible, controls are trustworthy.

Most reliable because... the absorbent is continuously reconcentrated automatically. No moisture-sensitive instruments are required to control your conditions... no solids, salts or solutions of solids are used and there are no corrosive or reactive substances.

Most flexible because... you can obtain any condition at will and hold it as long as you wish in either continuous production, testing or storage.

Write for Bulletins 112 and 131 and complete information on your air conditioning problem.

NIAGARA BLOWER COMPANY

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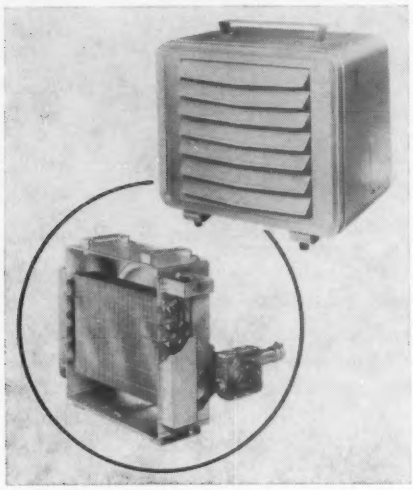
Niagara District Engineers in Principal Cities of U. S. and Canada

New PRODUCTS

(Continued from preceding page)



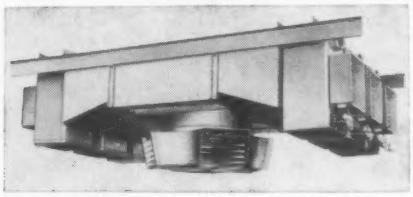
Electric Fan-Forced Unit Heater

Purpose: Furnish electric heat in stores and small plants.

Features: Unit heater is constructed of stainless steel finned sheaths which contain helically-coiled, nickel-chromium alloy resistance wire. Exterior is of steel and finished in corrosion resistant synthetic enamels.

Capacities of the Heetaires Series 600 range from 2KW to 10KW with 208, 240, 280, and 575 volts in single and three phase current. Has built-in or remote thermostat.

Source: Markel Electric Products, Inc., Dept. AE, Buffalo 3.



Duct Heater Assembly

Purpose: Supplement or completely heat industrial and commercial buildings.

Features: Assemblies are completely self-contained, consisting of two, four, or six gas-fired duct heaters, a plenum chamber, motor-driven fan, and fixed or revolving discharge.

Available in five sizes ranging from 368,000 to 1,104,000 Btuh output capacities.

Single heater can provide heat to floor areas up to 132 by 132 ft., with mounting heights to 50 ft.

Source: L. J. Wing Mfg. Co., Dept. AE, Linden, N. J.

Absorption Type Silencer

Purpose: Silencing line noises from centrifugal and positive displacement blowers.

Features: Unisilco silencer is of heavy-duty construction with continuous welded seams, crimped ends, and femal pipe connections on both ends. Absorbent material is enclosed around the perforated air passage tube and covered by the outer shell.

Resistivity to flow is approximately equivalent to an equal length of straight pipe. Available in 10 sizes from ½ to 4 in.

Source: Universal Silencer Corp., Dept. AE, Libertyville, Ill.

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Inclined Tube
DRAFT
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give you features that assure accuracy and long service life!

LARGE oil chamber with expansion compensating system. Constant zero (no oil in tube over scale at zero). Level and tube replaceable in field. Coreprene tube packing. Easy reading scales. Over 50 sizes. Wide range of scale lengths, ranges and increments, including 30" scale reading up to 10" of water, in .05" increments. The Ellison line includes both stationary and portable inclined tube draft gages — regular and laboratory type. Also pitot tubes and compact gage sets. Send for Bulletin 109-D.

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FOR 99 PLUS % EFFICIENT CORROSIVE FUME REMOVAL and MAINTENANCE FREE OPERATION

CARPART
(TYPE CF)
FUME SCRUBBERS
500 cfm to 40,000 cfm Capacities

efficiencies on:
• CHROMIC ACID 99.4% to 99.8%
• SULFURIC ACID 99.4% to 99.5%
• BRIGHT DIP MIX 99.8% to 99.9%

Fabricated Entirely of Boltaron unplasticized PVC

• LOWER INITIAL COSTS!
• LOWER ERECTION COSTS!
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Effectiveness due to combination of 4 stage water curtain with baffled impingement and continuous centrafugal heavy particle separation.

For Engineering and Application Data on Boltaron PVC Fume Scrubbers and Plastic Exhaust Systems, contact . . .

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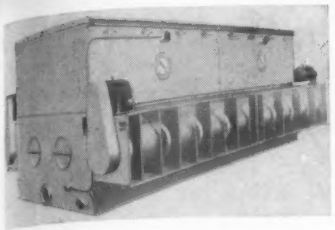


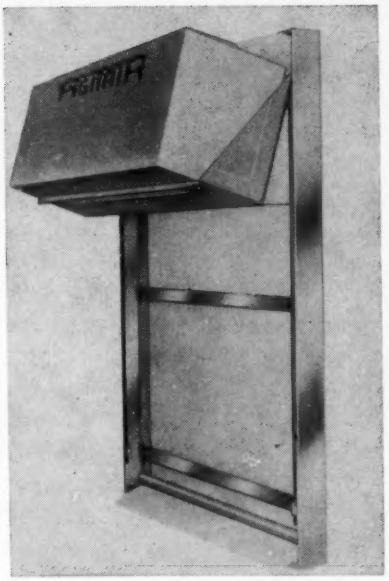
700-Ton Evaporative Condenser, Cooling Tower

Purpose: Bigger sizes offered in factory-assembled packaged unit as standard line to cover any air conditioning or refrigeration application.

Features: Three models of both cooling towers and evaporative condensers offered: blow-through and draw-through units with centrifugal fans and blow-through units with tubeaxial fans.

Blow-through models up to 100 tons offered with connection flanges for ductwork on air inlets as well as outlets.

Source: Baltimore Aircoil Co., Inc., Dept. AE, P. O. Box 7322, Baltimore 27, Md.



Pull-Down Filter

Purpose: Manual replacement of filter media in commercial and industrial air systems.

Features: Line of Type DS (Definite Seal) Agitair pull down filters are manually operated, eliminating motors and controls. When media is required, the clean filter is pulled to required length and dirty media is snipped off and discarded.

Media is 2 in. thick glass fibre with excellent efficiency and high dust retention.

Source: Air Devices, Inc., Dept. AE, 185 Madison Ave., New York 16, N. Y.

Activated Charcoal Paint

Purpose: Gives odor adsorptive properties to containers, rooms, fabrics, and various types of filter construction.

Features: Paint is made of high grade powdered activated charcoal with a binding agent which gives good film properties and does not deter effectiveness of the charcoal.

Called X-21, paint is water soluble and can be removed by scrubbing upon completion of decontamination. Paint is black and is available in quarts, 1-gal, or 5-gal containers.

Source: Barnebey-Cheney Co., Dept. AE, Cassady at Eighth, Columbus 19, Ohio.

System Balancing Techniques

(Continued from page 38)

control of outlet delivery, associated with high velocity systems, is usually unacceptable in systems which operate at conventional pressures, other means for volume adjustment and measurement must be used. It becomes necessary to measure air flow at each outlet, and to adjust the flow to each so that its delivery is in the proper proportion to the total flow of the system. Final capacity adjustment is then made for the system as a whole by adjusting the fan speed as required.

In order to proportion the flows, a particular sequence of adjustment will result in the most efficient procedure. As one outlet delivery is changed, volume and pressure changes which result will be reflected throughout the system. The sequence recommended is one which will result in the minimum necessity for resetting or remeasuring those outlet deliveries which have already been adjusted.

The theoretical principle underlying the recommended balancing procedure is that flow to all the outlets downstream of a given point will vary by the same percentage, when the pressure at that point is varied.

For purposes of illustration, Fig. 1 shows a relatively simple system having three branch mains. Flows shown are design deliveries. If the pressure at Point 1 is doubled, deliveries at outlets A through E will be increased by approximately 40 percent.

A double duct system would present additional problems in balancing for a number of reasons: 1. the flow requirements of either the hot or the cold deck will vary as the room temperatures change, 2. the mixing dampers used for double duct low velocity systems are not linear as to total flow as their position changes, even though the static pressure in the main remains constant, 3. the static pressure in the mains varies, as the flow through each main changes in response to the room temperatures. Should such a system be balanced with all air through the cold deck? The hot duct? Something in between?

The answer must depend upon the basis on which the system was designed. Many engineers prefer to size the cold duct to handle 100 percent of the system delivery, and the hot duct for something like 60 percent of total delivery. For systems so designed, balancing should be done with all hot duct dampers closed.

Any inadequacy in delivery through the hot deck can then be compensated for by merely rescheduling the hot duct temperature upward.

Next month, Part II will take up techniques of system balancing for both high velocity and conventional velocity air handling systems, and their supplementary hot and chilled water systems. ▲▲

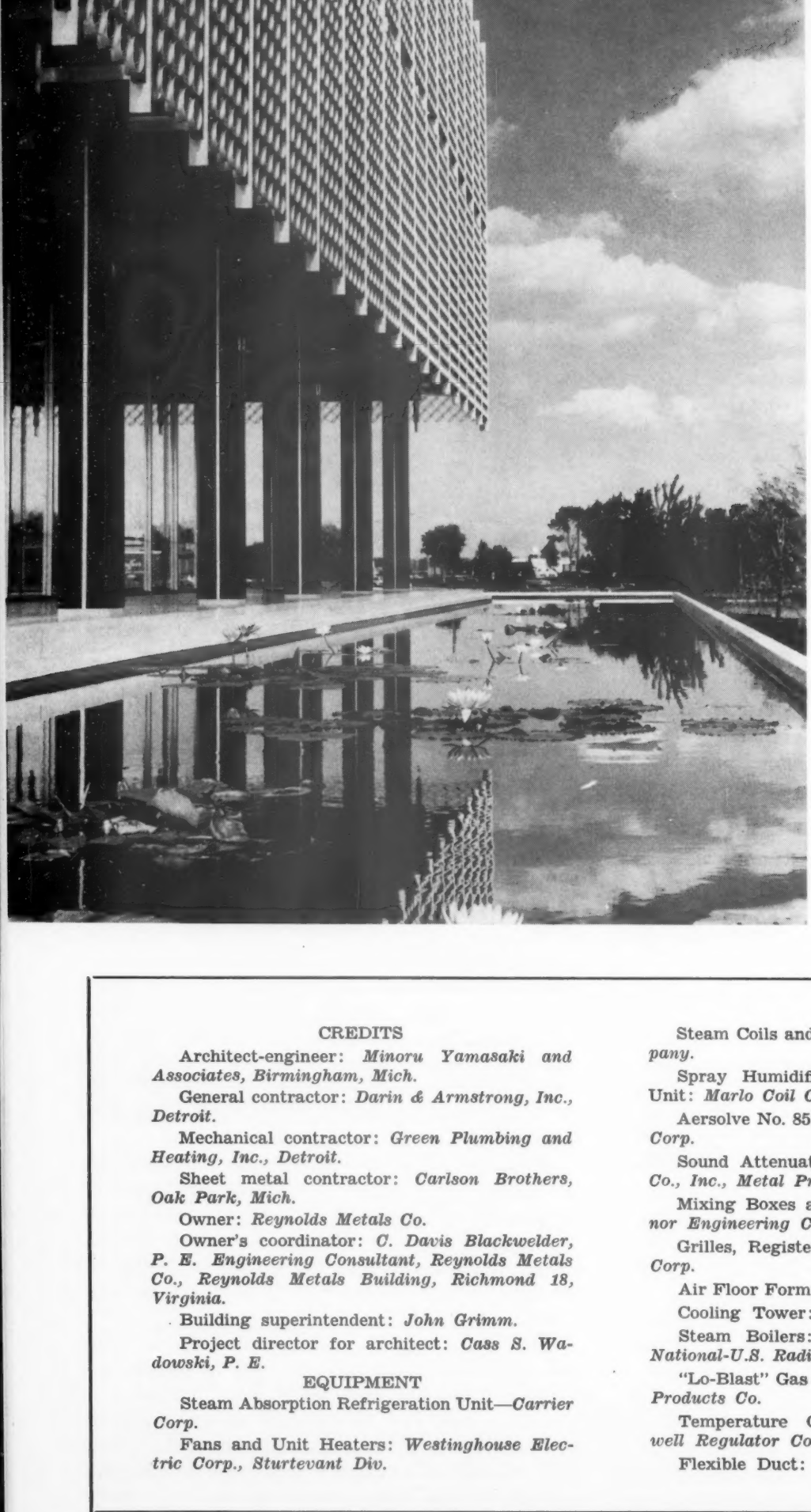


Fig. 9: *Sunscreen shown in this photo is credited with reducing solar gain to building by over 50 percent . . . even more than 50 percent on south wall. Screen is made of anodized aluminum of 10½ in. diameter extruded rings, 2¼ in. deep. Above the seven foot height, rings are 1¼ in. deep.*

CREDITS

Architect-engineer: *Minoru Yamasaki and Associates, Birmingham, Mich.*

General contractor: *Darin & Armstrong, Inc., Detroit.*

Mechanical contractor: *Green Plumbing and Heating, Inc., Detroit.*

Sheet metal contractor: *Carlson Brothers, Oak Park, Mich.*

Owner: *Reynolds Metals Co.*

Owner's coordinator: *C. Davis Blackwelder, P. E. Engineering Consultant, Reynolds Metals Co., Reynolds Metals Building, Richmond 18, Virginia.*

Building superintendent: *John Grimm.*

Project director for architect: *Cass S. Wadowski, P. E.*

EQUIPMENT

Steam Absorption Refrigeration Unit—*Carrier Corp.*

Fans and Unit Heaters: *Westinghouse Electric Corp., Sturtevant Div.*

Steam Coils and Convectors: *The Trane Company.*

Spray Humidifier Coils and Air Handling Unit: *Marlo Coil Co.*

Aersolve No. 85 Air Filters: *Cambridge Filter Corp.*

Sound Attenuators ("Aircoustat"): *Koppers Co., Inc., Metal Products Div.*

Mixing Boxes and Air Recovery Cells: *Connor Engineering Corp.*

Grilles, Registers and Diffusers: *Titus Mfg. Corp.*

Air Floor Forms: *Airfloor Corp. of California.*

Cooling Tower: *The Marley Co.*

Steam Boilers: *Pacific Steam Boiler Div., National-U.S. Radiator Corp.*

"Lo-Blast" Gas Burners: *Mid-Continent Metal Products Co.*

Temperature Controls: *Minneapolis-Honeywell Regulator Co.*

Flexible Duct: *The Wiremold Co.*

New Reynolds Building

(Continued from page 28)

maximum of 140F at outdoor temperature of -10F, and it is at mixed air temperature at outdoor design temperature of 95F dry bulb. It is desirable to have some reheat accomplished by the warm air duct during partial cooling loads in order to maintain better humidity conditions in the occupied space.

Chilled water coils are the sprayed type, with water recirculated from the basin to spray nozzles spaced across the entering side of the coil. During the day or occupied hours, the spray pump runs continuously, except when the outdoor temperature falls below 40F. Below this temperature, humidification may cause condensation on the windows. During night or unoccupied hours, the spray pump is inoperative.

Supply and return air fans operate continuously during the day. At night, fans are controlled by night thermostats and operate only when space temperature drops below thermostat settings.

The refrigeration system is inoperative at night. In addition, outdoor and exhaust dampers are fully closed and return air damper is fully opened at night. Toilet exhaust fan is also under day-night control.

The air conditioning system has operated through part of a cooling season and part of the present heating season. To date, the system has required only the usual adjustments common to a new building with a complex mechanical system.

Open House Was Test

The most severe test of the system occurred during a week of "open house," wherein various groups of civic leaders, industrialists, contractors, architects and engineers were invited to inspect the building. The number of people present each evening exceeded by far the design occupancy, but the air remained fresh and the temperature comfortable.

The refrigeration system was designed to maintain 76F dry bulb and 50 percent relative humidity at outdoor design conditions of 95F dry bulb at 75F wet bulb. Actually, room thermostats are set at 74F dry bulb the year round.

The ability to maintain lower room temperatures is due partly to success of the sun screen. The anodized aluminum screen is constructed of 10½ in. diameter extruded rings, 2¼ in. deep. Above the seven foot height, the rings are 14 in. deep. The screen plus the walkway gratings proved to be more effective than originally estimated. Instead of reducing the solar gain by 33 percent as estimated, the screen has reduced the solar gain by over 50 percent – even more so on the south wall Fig. 9.

Effectiveness of the sun screen has another decided advantage, when the type of air distribution system is considered. The air floor is a radiant heating and cooling system in addition to being a ventilation system. A radiant system has an inherent time lag because of the flywheel effect of the large mass in the floor, and responds slowly to sudden fluctuations in cooling load, such as solar gain.

Many Problems Arose

Numerous problems arose during the design and operation of the air conditioning system. Some of the outstanding problems and their solutions will now be discussed.

At the time the mechanical systems were designed, there was little information available on high pressure duct construction details. Previous publications were reviewed and information tabulated. Local sheet metal contractors with experience in high pressure systems were consulted in an effort to learn which details conformed to good practice. From this study evolved a set of details for high pressure duct construction which has stood the test of time, with only slight modifications.

The confined space available for ducts and mixing boxes above the furred ceiling space – approximately 6½ ft. wide by 2½ ft high – was too small to permit use of the standard end outlet mixing box. Preliminary sketches indicated that a mixing box with top outlet would satisfy the space requirements.

Further checking with manufacturers proved beneficial, because it was learned that the size of top outlet could be cut to match in size the underfloor duct that connected to it. Another concession by the successful box manufacturer was furnishing of the box with size of inlet openings to match the flexible duct diameter connecting to it. This slight alteration saved a transition at the inlet and reduced noise and static pressure requirements.

The ventilation system was used for temporary heating during construction. This is a normal procedure. However, if filters are not used, mixing boxes and ducts load up with construction dirt in a short time. The mechanical contractor did not want to be penalized by having to provide a set of replacement filters, because the filters specified are a high efficiency type and, naturally, are more expensive than less efficient types. The contractor was permitted to use a temporary bank of throwaway, glass fiber filters during construction. Before the building was turned over to the owner, the permanent filter bank was installed, thereby not burdening the owner with a set of loaded, dirty filters before he has occupied the building. This procedure has been incorporated in all specifications for future work.

When the refrigeration system was first operated and tested, it was not possible to obtain design conditions on the leaving side of the sprayed chilled water coils. Further tests indicated that the air was not passing through the entire coil face area. The sheet metal contractor added short, vertical, diverging baffles on the leaving side of the sound attenuator in

(Please turn to page 51)

Better Air for Industry

PART V

by Richard V. Sloan, *Senior Engineer*
American Air Filter Co.
Los Angeles, Calif.

10 Don'ts In Selection And Application Of Dust Collectors

A CHECK LIST OF THINGS not to do in the selection and application of dust collecting devices should be useful. Reviewing items such as the following would save many a sour or ineffective dust collecting system.

(1) Don't hope to provide a dust collector by tying a burlap bag over a discharge pipe, or by directing the discharge duct into a barrel of water or a settling chamber.

Factors involved in the collection of small particles do not lend themselves to such elementary treatment. Hundreds of times each year, hopes are blasted in such attempts at the cost of dollars, man-hours, and loss of face.

(2) Don't put two collectors of the same order of efficiency in series. The second collector will not remove enough material to alter discharge appearance, public nuisance complaints, or settlement in plant area unless initial unit is not functioning satisfactorily.

Exceptions could include installations where agglomeration of particles are involved, or where a second collector is used to remove material concentrated in a carrier air stream from the first collector.

(3) Don't visualize discharge appearance based on efficiency data. Fine particles have many, many more light reflecting surfaces per pound than coarse particles.

Appearance of effluent air will be governed by efficiency of collector, particle size of contaminant, and concentrations of solid particles. Often the removal of 85 percent of solids from a local exhaust system will make no visual change in the discharge stack appearance.

(4) Don't expect dust collection equipment design to be more advanced than productive machine design. Generally, the higher the degree of effectiveness, the more certain the need of periodic servicing, inspection, and part replacement.

Such operations will not receive proper attention where (1) collectors are placed in inaccessible locations without ladders, working platforms, and lighting, and (2) in outdoor locations where workmen are exposed to rain or winter weather.

(5) Don't wait for dust collectors to fail before ordering replacement parts. Periodic inspections will give ample warning. Under present day working conditions, failure of a dust collector can mean halting production lines while long distance calls and air express shipments attempt to reduce the downtime.

(6) Don't expect collectors employing principles used for low efficiency primary collection to be developed that will give efficiencies equal to those of more expensive high efficiency units – hopes of the purchaser and enthusiasm of the inventor notwithstanding.

Cost to American industry of such hopes and enthusiasm each year is tremendous. Designs using centrifugal forces in a dry unit are expensive misapplications. No twist of a piece of metal will make fine dust particles forsake the laws of aerodynamic behavior.

It should be apparent that no one method or design will be suited for all industrial problems, if variation of concentration, particle size, and percentage of removal necessary are correctly evaluated.

(7) Don't expect replacement of exhaust air volume to slip in through cracks in windows and doors without creating cold drafts in winter months and often starving exhaust systems so that effectiveness is reduced. Makeup air supply systems can improve control, eliminate drafts, and warm the incoming outside air efficiently.

(8) Don't attempt to recirculate cleaned air from dust collectors handling toxic material without careful investigation of the policing required to be assured of maintained effectiveness.

(9) Don't install unit collectors on heavy duty production equipment operations without careful evaluation of the frequency of servicing that could be required.

(10) Don't expect collection equipment to function properly if hooding and connecting ductwork are not in accordance with good dust control practice.

Next month the author discusses make-up air problems and the handling of toxic fumes. ▲▲

Radioactive Levels

(Continued from page 41)

taken from the National Committee on Radiation Protection recommendations as given in the new National Bureau of Standards Handbook 69. Values are specified in these tables for exposures to persons in restricted areas and levels of radiation and concentration in unrestricted areas. The values given limit the radiation and concentrations of radioactive materials in unrestricted areas to extremely low levels.

A new table entitled "Body Burden" not present in the previous standards has been added to the new proposed amendment. This table specifies that quantity of each of the listed radioisotopes which when present in the body is calculated to deliver a dose rate not more than 0.6 rem/week to thyroid or swink, 0.56 rem/week to bone, 0.1 rem/week to the gonads or total body, or 0.3 rem/week to other organs of the body.

The reduction in limits on permissible exposure to radiation which would be accomplished by adoption of these amendments should not be interpreted as an indication that exposures at limits previously permitted caused damage. ▲▲

REFERENCE:

1. Letter "Notice to Licensees of prepared amendment to 10 GFR. 20" Standards for Protection against Radiation" from H. L. Price, Director, Division of Licensing and Regulations. Atomic Energy Commission, Washington 25, D. C., May 4, 1959.

Reynolds Metals Building

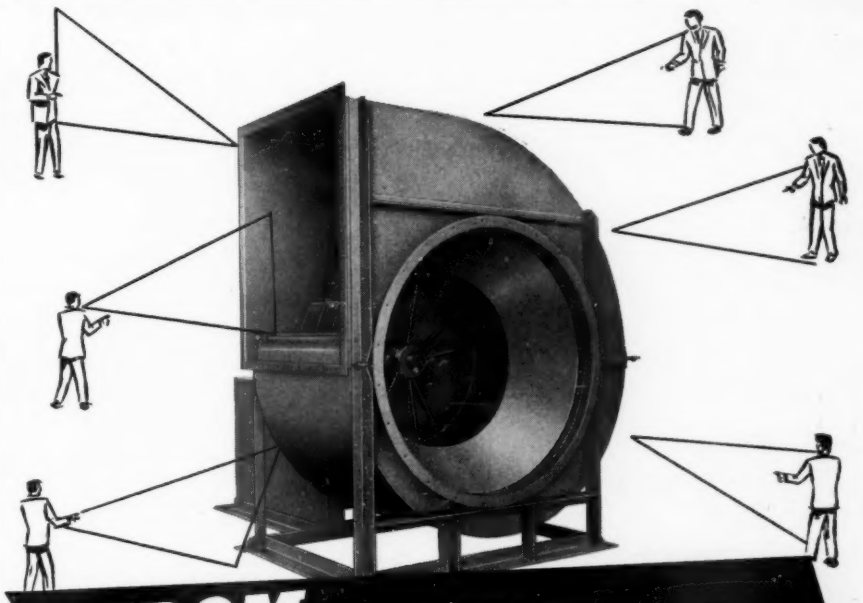
(Continued from page 49)

the duct transition upstream of the spray coils. The baffles helped to spread the air evenly over the entire surface of the coils, and design conditions leaving the coils exceeded the requirements. The baffles proved necessary even though included angle formed by the duct transition was within limits of good practice.

The steam absorption refrigeration machine requires a constant supply of steam at 12 psi. During initial weeks of operation, steam pressure from boilers varied from 10 psi to 13 psi, limits of the steam pressure control setting. At the lower steam pressure, the absorption machine lost capacity rapidly. At the higher steam pressure, the absorption machine was deenergized by the high temperature safety limit control. This condition was corrected by adjusting steam pressure controls to operate with a minimum differential.

When the steam absorption machine was first tested for an extended period, chemical treatment system for the condenser water system had not been in operation. In a matter of days, the condenser water tubes started to scale and refrigeration capacity decreased accordingly. Upon contacting the manufacturer's representative, it was learned that the refrigeration system should not be placed in operation until the chemical treatment system was operating also. A temporary, mild acid solution was introduced into the condenser water by the chemical treatment equipment to remove the scale, tended period, chemical treatment and this was followed by the chemical treatment as specified. Nor further problems developed.

During the past month, daytime outside air temperatures dropped as low as 12F above zero, with no downdrafts from the glass skylight. All interior design conditions were met, and there were no complaints from the office personnel, despite widely varying heating requirements within the building. ▲▲



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New Literature

Kathabar Air Conditioning and Drying Systems Brochure

Bulletin K-160 describes the latest (Model C) Kathabar air conditioning and drying system equipment. It contains principles of operation and actual applications of the equipment.

Kathabar climate control rooms are also shown.

Source: *Surface Combustion, Div. of Midland-Ross Corp., Dept. AE, 2375 Dorr St., Toledo 1, Ohio.*

Air Distribution Catalogs

Comprehensive set of eight catalogs describes wide range of air diffusion equipment. They cover circular, square, straight line, and perforated diffusers, Diffus-A-Plate, air diffuser accessories, high velocity units, and constant volume turbulators and LPL valves.

Catalogs contain dimension drawings and tables and cfm capacity, static pressure, and radius of diffusion rating for every available diffuser size.

Source: *Anemostat Corp. of America, Dept. AE, 10 E. 39th St., New York 16, N. Y.*

Tetraethyl Lead In Motor Fuel

A report on "Public Health Aspects of Increasing Tetraethyl Lead Content in Motor Fuel" has been published by the U. S. Dept. of Health, Education, and Welfare.

Report was made by an advisory committee on Tetraethyl Lead to the surgeon general of the Public Health Service. The committee met in January, 1959, and found no indication that an increase in the concentration from a maximum of three to a maximum of four cu cm per gallon of gasoline would significantly increase the hazard to public health from air pollution.

The committee expressed concern however about the inadequacy of medical data on which to base a conclusive answer to the problem.

Price: 30 cents.

Source: *Superintendent of Documents, U. S. Govt. Printing Office, Dept. AE, Washington 25, D. C.*

Dust Control Equipment

Complete range of Dracco dry collection equipment is described in Bulletin 805. This 28-page bulletin describes ways of using cloth filtration and cyclonic equipment for eliminating dust control and air pollution problems in industry.

Source: *Dracco Div., Fuller Co., Dept. AE, Harvard Ave. & E. 116th St., Cleveland 5, Ohio.*

Industrial Ventilation Manual

Enlarged sixth edition of Industrial Ventilation Manual is completely re-edited. It is official publication of American Conference of Governmental Industrial Hygienists and contains recommended practices approved by Federal, state, and municipal government industrial hygiene departments.

Manual contains all information needed for complete design of industrial ventilation systems. Price: $7 in hard cover, $4 in flexible cover.

Source: *Committee on Industrial Ventilation, Dept. AE, P. O. Box 453, Lansing 2, Mich.*

Motors Bulletin

GE fractional horsepower general purpose motors are featured in Form GEA-6424A.

Sixteen different kinds of fhp motors are described in this 12 page form, ranging from motors for machine tools to room air conditioner motors.

Frame sizes range from 48 through 56 NEMA.

Source: *General Electric Co., Dept. AE, Schenectady 5, N. Y.*

Horizontal and Inclined Grate Coolers

Both horizontal-grate and inclined-grate coolers for materials cooling after processing in rotary kilns, sintering machines, etc. are discussed in a new eight-page illustrated bulletin CO-7. So is the clinker-breaker designed to work with them.

Schematic drawings show units' simplified design and reduced height which permits installation where bulkier units could not be used.

Source: *Fuller Co., Dept. AE, Catasauqua, Pa.*

Hydrocarbon Detector Brochure

Model 213 detector, as offered by Perkin-Elmer, is described in a new eight page brochure. Illustrated is self-contained portable unit used for rapid measurement of total organically bonded carbons in atmosphere or gases.

Brochure lists typical applications such as measurement of unburned hydrocarbons in automotive exhaust gases and atmospheric monitoring in air pollution.

Source: *Perkin-Elmer Corp., Dept. AE, Norwalk, Conn.*

High Pressure Air Handling Unit Bulletin

Complete product and engineering data describing Drayer-Hanson high pressure air handling units is contained in brochure HCD 341.04.

Spotlighted are reproductions of typical hot and cold duct air conditioning unit, with cutaway; and dimensional drawings, table of dimensions, and nominal ratings.

Source: *Drayer-Hanson Div., National-U. S. Radiator Corp., Dept. AE, 3301 Medford St., Los Angeles 63, Cal.*

Packaged Boiler-Burner Units

Kewanee forced draft square-heat packaged boiler-burner units are described in Form No. 1145.

Dimensions, ratings, and technical tables are included along with typical specifications and list of standard accessories.

Source: *American-Standard, Industrial Div., Dept. AE, Detroit, 32, Mich.*

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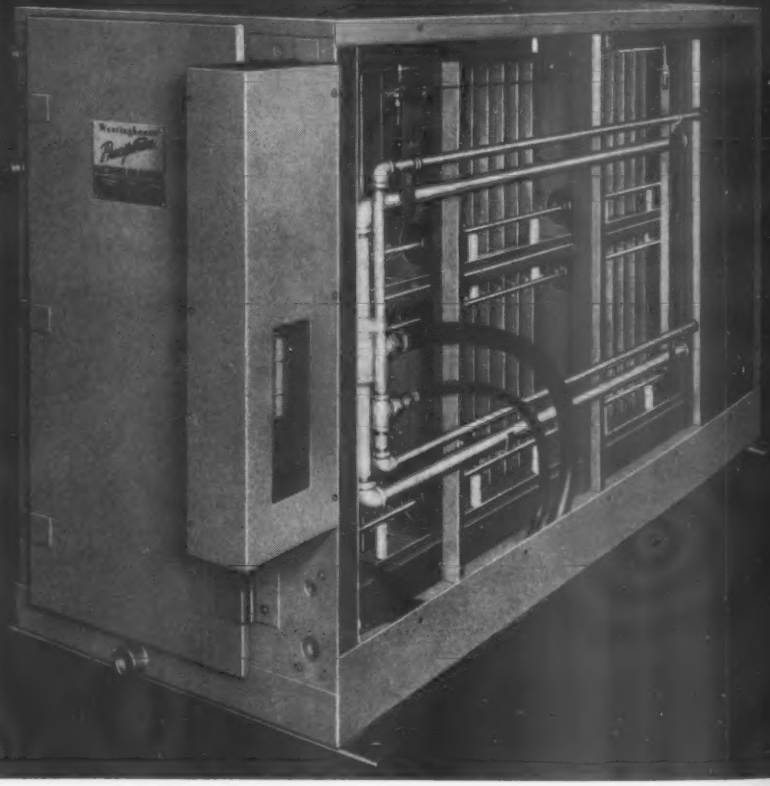

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